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DANGER FROM LARGE GAS MAINS.

A valve in a gas main which furnishes the supply to Mount Vernon and Pelham, two towns a short distance from New York city, broke recently, during the night, and shut off the gas for a couple of minutes, when it came on again. The time of shutdown was sufficient, however, to put out all lights which had been left burning, and upon the renewal of the supply the gas, of course, poured out through all open burners. The danger was quickly recognized by the gas department and others, and the gas turned off, and an active campaign was started to awaken all users of gas in that district. So far no deaths have been reported; but there can not be any doubt that the danger did exist. The gas company did not think it safe to turn on the supply again until noon of the next day, thus causing considerable inconvenience to those who depend upon gas for cooking and heating. Now that we have a better system of illumination, we are beginning to recognize the dangers of the old. It is very probable that this method of illumination would never have been tolerated had it not been the best and safest system when it was first introduced.

NEW FACTORS IN CIVIL LIFE.

When the electric railway had clearly shown its suitability for urban transportation, and had begun to reach out into the outlying districts and bind them closer to the cities, a new factor, making for the good of the city, was recognized. It was seen that a system of transportation which could be operated over city streets without creating an unbearable nuisance, and which could also make good speeds in the thinly settled or country districts, would make it possible for those working in the city to make their homes some distance from their places of business, and yet not have to sacrifice too much time in going to and fro. When, in addition to the other advantages of suburban life, it was shown that, even adding the cost of riding to the lower rents of those sections, there was still an advantage in its favor, it was felt that the new influence, tending to distribute over wide areas the workers of a large city, would prove to be a powerful force in relieving congested districts, in purifying overcrowded, unhealthy tenements, and in bringing air and sunshine to many who before had been compelled to live without them. In these expectations we have not been disappointed, for the effect of the electric railway has been most beneficial. It was as though fresh blood was being infused into the exhausted and sluggish localities through the new veins and arteries formed by the networks of railroads which have spread through and out from our cities.

The Telephone in the Country.

Another of the important factors in our present-day civilization is the telephone. The value of this quick and easy means of communication is well recognized to-day, and an accident such as happened recently in New York city served to bring home to the busy man, who has given little thought to the work that is being done by the engineer, how much he depends upon the new art. The value of the telephone in other fields has been pointed out on various occasions. It brings to the isolated country home a sense of security, and makes the residents of a whole county neighbors. It enables the farmer to watch the markets, so that he may sell his products to the best advantage, without trouble or waste of time. In other ways, the telephone, which first made its impress upon the city, is now working for the good of the thinly settled country.

The Telephone as a Reformer.

The influence of the telephone is being felt in another field. It has been used in Missouri to baffle the attempts of a political boss to call snap primaries and force upon the party his own candidates. By means of the telephone all the voters, even those most distant, were quickly notified and called together, and the scheme was defeated. Thus the telephone becomes an agent for the good of the state. And in this it is assisted by the electric railway which affords an easy means of traveling for those called

by the telephone. The disadvantages of distance have been greatly overcome, and the citizens of a county may be brought together or kept informed of every political movement almost as easily as when, in colonial days, the whole state was nothing but a small settlement. It seems as though these two new arts would be potent factors in bringing back to the people much of the political power which has passed from them, to self-appointed leaders, because the voters are scattered over a thinly settled country. May they not prove to be powerful weapons for the protection and strengthening of democratic institutions?

THE ETHICS OF FAKES.

Not infrequently our opinion is sought regarding some new device purporting to operate by electric or magnetic means. A number of these devices have been for therapeutic uses, and the enquirer either was seeking for a remedy for himself or a friend, or is considering investing in the device.

The Side of the Fraud.

When the device is undoubtedly a fraud, there would seem to be no choice in the advice to be given. But are there not some arguments for the other side? Take, for instance, an alternating-current electromagnet which the inventor claims acts wonderfully to relieve pain. One can not deny that this produces a magnetic field about the patient, and this magnetic field may affect him, possibly by setting up weak electric currents, if in no other way. Admitting this, it reduces argument against the device to a mere statement of disbelief in its powers, an argument which can always be answered by testimonials from persons who honestly believe that they have been benefited by its use. That such cures have been effected can not be denied, but it is difficult to say whether they are due to the physical action of the device, or to its effect upon the mind of the sufferer. This raises the question, whether a faith cure produced in this way is not as justifiable as one brought about by the use of inert medicines. If the enquirer is seeking for an investment, in many cases it is highly probable that the device would prove profitable. Add to this the fact that it may prove beneficial, and many would feel justified in investing in it.

No Justification for Encouraging Frauds.

On the other hand, should these schemes be encouraged, the enquirer is looking for a good investment. Probably the device in question would prove to be one. He may believe in it thoroughly, and it is impossible to disprove his claims. To advise him to develop it might be considered good business sense. It can not be proved to his satisfaction that the device is not beneficial—at least, in some cases—and in those cases where no good is accomplished, probably no harm would be done, beyond the expenditure of a little money; yet all these arguments do not seem to be sufficient excuse for any one to encourage a scheme in which he does not believe, even if it promises to be a good investment. Is the one whose opinion is sought justified in any case in doing otherwise than expressing his opinion of the device plainly and advising against it?

AN UNUSUAL ACCIDENT.

On the twenty-eighth of March the necessity of carrying out some repairs at the Charing Cross & Strand Electricity Supply Corporation's generating station at Bow, London, called for the shutting down of the generators at this station. The Bow station generates three-phase current at 10,000 volts, the energy being transmitted to substations in various parts of London, where it is transformed to continuous current by means of motor-generators. Six cables are used for the transmission at high voltages for the City and West End. These have a total length of thirty-six miles, and are three-core cables, the sectional area of the cores being one-tenth of a square inch.

Conditions When Accident Happened.

The stopping of the station was carried out in the usual manner. After all the substations had disconnected their motor-generators, the engineer at the generating station reduced the generator speed until the engines were merely turning over. He then disconnected the generator fields, and finally opened the main switches. The voltmeter at this time stood at zero. Everything apparently being quite safe, the switchboard attendant, George Crates, proceeded to remove the high-tension fuses. These fuses are contained in heavy glass tubes, and are about eight inches in length between the metal terminals. A pair of insulated tongs is provided for disconnecting fuses when in service, but, on this occasion, was not used, there seeming to be no necessity. After removing the two sets of fuses from two cables safely, Crates drew out the first fuse of the next cable. Instantly there was a flash and a report, and he fell back unconscious, holding the fuse in his hand. Every effort was made to revive him, but he died before the physician called could reach him. His body showed few marks of the shock. He was not burned, but his hands and arms, and face between the eyes, showed slight red marks.

At first sight it seems difficult to account for this unusual accident, as the generators had been disconnected. These are star-wound, with the centre earthed, and during this operation the earth connection was removed. The voltmeter had indicated zero, which would not have been the case had the motor-generators been sending current back over the line; and it is known that these were disconnected. The London *Electrician* attributes the accident to a residual electrostatic charge on the cable, which accumulated after they had been disconnected and before the fuse was pulled out. This is a familiar phenomenon of the ordinary condenser, and has frequently been observed when testing cables in cable factories. It is possible that Crates was affected with heart trouble, and that this was the actual cause of his death, the crisis being brought on by the electric shock. But in any case, the accident emphasizes a possible danger to employés in high-tension transmission systems. The only safe rule would seem to be to treat such high-tension cables as dangerous under all conditions, to avoid handling them as far as possible, and, when this is necessary, to adopt all precautions, such as permanently grounding them while repairs are being made.

THE ELECTRICAL MANUFACTURE OF STEEL.[1]

BY GUSTAVE GIN.

The following article is an abridged translation of M. Gustave Gin's description of his latest process for the production of steel by electrical means. The principle involved—that of heating a thin stream of metal by the passage of an electric current—is rather novel, and its originality justifies some notice of the process.

This method has been operated, the translator understands, only in an experimental way, thus far, and it therefore remains to be seen whether the calculations of the inventor can be realized in practice. Lacking such actual commercial operation, the translator wishes to disclaim any responsibility for such claims as may be advanced by M. Gin for this process.

It should be noted that the units mentioned are in the metric system, the ton referred to being equivalent to 2,204 pounds avoirdupois.

GENERAL CONSIDERATIONS.

The changes in physical states and the reciprocal reactions of substances involved in the industrial production of iron and derived metals, require the consumption of a certain amount of energy, hitherto obtained by the combustion of carbide; in the present process an attempt is made to replace this by electrical energy.

The technical solution of this problem may now be considered an accomplished fact; but it is advisable to make certain reservations as regards the economic results. It must not be forgotten, in fact, that while electricity is the most tractable of the forms of energy, it is, generally speaking, also the most costly. It should not, therefore, be employed, except knowingly (with a thorough understanding of the conditions), and its use should be limited to those applications where its superiority is clearly evident. By carefully examining all the data of the problem, it appears certain that the application of electrical energy to the direct extraction of iron from its ores can not be advantageous, except under certain exceptional conditions.

Besides, it must be recognized that the modern blast furnace, to the perfecting of which so many metallurgists have concentrated their efforts, is a marvelous metallurgical instrument, in which the utilization of heat energy approaches so closely to perfection, that it is seeking Utopia to attempt to substitute for it the electrical furnace. Such a substitution is, furthermore, inconceivable, except in certain localities particularly favored as regards electrical energy and minerals.

But it becomes a different matter when electrical energy is used for the conversion of crude cast iron into steel. In this case the electric furnace clearly has the

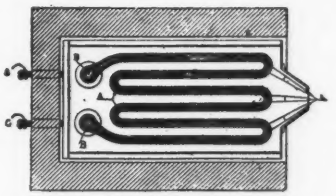


FIG. 1.—GIN STEEL FURNACE.

advantage of the Martin furnace, always providing that the electrical energy may be obtained at an acceptable price, either by the employment of hydraulic power for generating purposes or by the use of the energy available in the waste gases from blast furnaces.

As soon as there is accomplished by the latter means the combination of the blast furnace for cast iron, the Bessemer converter for the common steels, and the electrical refinery for the higher grade steels, the industrial metallurgy of iron will have realized an almost perfect utilization of the heat energy of coal.

GIN PROCESS.

From the data submitted by Dr. H. Goldschmidt, of Essen, at the recent fifth congress of applied chemistry, at Berlin, it appears that the first electrical furnace for the manufacture of steel was proposed by M. Gin, in 1897.[1] Since that time researches upon this interesting question have been continued, and many new types of furnace for steel production have been studied. The latest type depends upon the

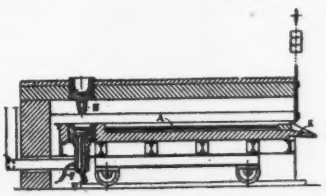


FIG. 2.—GIN STEEL FURNACE.

utilization of the Joule effect, without the use of carbon electrodes.

In the various types of apparatus devised up to the present time, to produce electrothermic reactions in fused cast iron, great difficulties have been experienced in utilizing the energy of the electric current in a bath, the resistivity of which scarcely exceeds 200 microhms per cubic centimetre; generally one is content to produce the Joule effect in a layer of slag floating on the metallic bath, using the notably higher resistivity of this slag.

Besides, the use of carbon electrodes is an obstacle to decarbonization, because reduction of the constituents of the slag is effected by the carbon of the electrode, rather than by the combined or dissolved carbon in the bath.

Finally, furnaces have been devised where the current which passes through the bath is generated by induction, and without the use of any electrodes. But it should be noted that such an apparatus is costly, and involves a considerable magnetic leakage, incompatible with an efficient utilization of electrical energy.

For the purpose of avoiding these undesirable features, the expedient of the slag bath, and the objectionable use of carbon electrodes, the idea arose of forming the electric furnace as a canal or channel of great length, and small cross-section; filling this canal with fused cast-iron, and having at its terminal blocks of steel cooled by an internal current of water.

The passage of the proper amount of current in the conductor of fused metal sets free a sufficient quantity of heat to maintain the whole mass in fusion, and to bring it to the most favorable temperature for producing the refining reactions. On the other hand, the large section of the blocks forming the terminals of the circuit prevents a great rise of temperature in them, being aided in this respect by the circulation of cold water.

To give a convenient form to the hearth, the canal in which the metal is held is doubled on itself several times, so that there is formed a sort of huge incandescent lamp, of which the filament consists of a stream of molten iron.

In practice the apparatus would consist of a movable carriage on rails, having a body made of refractory materials. In this carriage body is placed the hearth, containing a channel or canal, having rectangular and semi-circular cross-section A, and sinuous in a longitudinal sense. The ends of the canal connect with the terminals for the current supply BB, each of these consisting of a block of steel so shaped as to form an open basin in the canal. The terminal blocks carry a vertical downward extension, which serves for the connection G, with the conductors carrying the current. These terminal blocks are cooled by an interior circulation of water, which is introduced into the cavity D by means of the tube E, connected with a reservoir by means of a

[1] Reprinted from the *Electrochemist and Electrometallurgist*, London, March, 1904.

[1] French patent No. 263,788—February 6, 1897.

strong rubber tube; the water escapes by the orifice F, which is also connected by rubber hose to the sewer.

When a charge of metal is to be refined, the crucible carriage is placed in an arched furnace, in order to reduce as much as possible loss of heat by radiation. The furnace being in place, electrical connection is made at G, and the fused pig iron is introduced by the funnels H.

The dilution method (scrap process) may be employed by adding to the iron a calculated proportion of scrap iron, which dissolves in the fused bath. The carbon of the iron diffuses with great rapidity throughout the mass, and the conversion of the whole into steel takes but very little more time than that needed for the fusion of the added metal.

It is also easy to employ the method of oxidation, by the addition of some iron oxide (ore process). The oxygen of the iron oxide added to the bath burns the silicon, manganese and carbon. As in a furnace of this type the temperature can be raised at will, the carbon is eliminated with great rapidity, thus obtaining a more complete dissociation of the iron and carbon of the pig iron.

When the pig iron, or mixture of pig iron and scrap, has become well fused, the iron oxide is added by means of a shovel; quite a lively ebullition is produced, which lessens gradually. When the process of decarbonization is only manifested by the small blue flames which escape periodically at the surface of the bath, a further quantity of oxide is added. The same phenomenon occurs, but not so strongly marked this time, and the extent of decarbonization is judged by the feebleness of the blue flames.

At this time the best specimens may be taken, and, if necessary, the final addition of spiegel or ferromanganese may be made, although these latter are not so important in this as in other types of furnaces; this is particularly true with reference to the silicon generally employed to play the rôle of intermolecular combustible, this being quite unnecessary with electrical heating of the metal.

It is interesting to note that in this electric furnace the oxidation of the impurities of the pig iron, and notably that of the carbon, is brought about without the intervention of atmospheric oxygen. Thus the amount of dissolved oxide is reduced, and, consequently, the quantity of deoxidizing materials to be introduced at the end of the operation is lessened.

It should be remarked that the localization of the heating in the metallic conductor enables one to obtain temperatures which would not be realizable in furnaces of the Martin type without melting the arches, and consequent danger of spoiling the metal exposed on the hearth.

The dephosphorizing and desulphurizing materials may be introduced at practically any moment after the metal is well fused; either before, or during, or after the decarbonization. The removal of

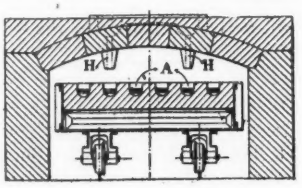


FIG. 3.—GIN STEEL FURNACE.

the slag is effected by means of an iron scraper, which is manipulated by the workmen from the front of the furnace.

The finished metal is poured at the openings K, which are placed at the front or end of the furnace opposite the electrical connections.

The method by oxidation (ore process) is dwelt upon at some length, and less has been said about the method by dilution (scrap process) on account of the considerable modifications that would be necessary in the section of the bath, and the necessity which it would entail of varying the voltage of the electric current between wide limits.

The dilution method only possesses real interest in the case of a factory exceptionally placed with reference to a supply of pig iron containing but little sulphur or phosphorus. In fact, it should be kept in mind that dilution without simultaneous oxidation would require the use of

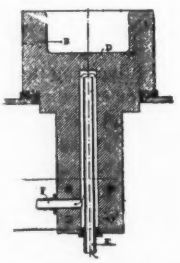


FIG. 4.—GIN STEEL FURNACE.

very pure materials, because the elimination of impurities would be insignificant.

All the advantages of these two methods may be combined, and their respective inconveniences avoided, by the use of a "mixed method," involving the use of a certain amount of scrap, and oxidation by the addition of iron oxide. It should be noted, moreover, that even in the Martin furnace the "ore process" is not rigorously followed, but that one-fifth of the total charge is scrap iron.

The following shows the manner in which it is proposed to operate the Gin furnace in practice:

The pig iron is treated with some iron ore and lime, so as to oxidize the impurities, while producing a basic slag, which facilitates the elimination of the phosphorus. When the purification is sufficient, the scrap iron is introduced into a very hot bath, the slag is removed when fusion is complete, and the final additions of ferromanganese are made, to reduce the oxide dissolved in the metal.

It is understood, of course, that the use of this mixed process is dependent upon the nature of the possible supply of raw materials; but it is especially adapted for those factories which can obtain at good prices scrap iron, rail ends, bars, sheets, etc., suitable for making proper mixes.

It is believed that this type of furnace will permit of the easy manufacture of special steels, by the direct incorporation of the additional elements—manganese, nickel, tungsten, vanadium, molybden, etc.

The materials of which the hearth of the furnace is constructed should obviously be sufficiently refractory to withstand the highest temperatures of the bath. Under this head, lime and magnesia would be preferable, if these bodies were not so easily converted into slag by the silica resulting from the oxidation of the silicon in the bath.

It is true that lime and dolomite play an important part as dephosphorizing and resulphurizing agents, but it is better to employ the calcareous materials mixed with the oxidizing agents. As for silicious linings, they are not sufficiently infusible to be used without rapid deterioration. The best protective coatings are found in rich bauxite, and above all in chromite of iron, which may be agglomerated by ordinary methods.

(To be concluded.)

The production of high-frequency currents by means of the telephone has been exhibited by M. Ducretet before the French Physical Society, employing the loud-speaking telephone of MM. R. Gaillard and E. Ducretet. The microphone and the receiver were placed in circuit with a battery of about ten volts, so as to give a current of about half an ampere. By suitably regulating the distance between the receiver and microphone free oscillations were set up which could be maintained indefinitely, and these were increased in intensity by connecting the microphone and receiver with a metal tube.

TELEPHONE ENGINEERING—III.

BY J. C. KELSEY.

THE SELF-RESTORING BRIDGING DROP SYSTEM.

The self-restoring drop in bridge did not play as active a part in public usage as its series counterpart. The system came too late, for the day of the local battery service for cities was on the wane. It did serve in cities of medium size, where competition had not commenced to demand the best efforts of the company. Many of the companies clung to the series system until the common battery era began. They also now use the self-restoring drop, but it is in connection with their multiple toll-boards. But there were telephone companies whose equipment got in such bad shape that they were forced to adopt some improvement. They had to build new branch offices, from time to time, after the trolley era began. Consequently, they had to build metallic lines, and it followed naturally that a metallic board was installed. Powerful electrical disturbances demanded a balanced system, and it is plain that a series drop would unbalance a connection. Hence the bridging drop.

It stands to reason that a new system would not have been adopted if no improvements had been made. That improvement was in the automatic restoration of the drops, without conscious effort of the operator. That served to save time. But the time was not saved to the public, because the company was compelled to get more service from their operators. The public could never see where any improvement came in on the adoption of this system from the service standpoint. It took just as long to get the operator and just as long to get the second party, but the lines were quiet, and the incessant busy test made upon the lines while talking was missing. The public had a sense of privacy, anyway.

But the weak link of the series system was present in the bridging system—that was the clearing-out drop. Subscribers would not ring off. The operator would be busy. Naturally, in a rush of business, she would go on using the pairs of cords readily available. She would not have time to test individual pairs, to see if connections were finished. Not having more than fifteen pairs of cords, she would soon have to refuse connections. The fact was, that knowing only a few of the pairs were really in use, she would reach up and pull down every cord in her position. This explains the frequent cutting off, in local battery days. The best the subscriber could do was to call again, and demand reconnection. The operator was blameless. She had no supervision over the connection. She could neither tell when the subscriber called had answered, nor when he hung up his receiver. To accomplish this supervision of both subscribers individually is one of the most essential elements in the design of the present-day common battery systems.

The bridging instrument, shown at left of Fig. 5, has the same talking circuit as the series instrument. The bell, which was cut out during conversation, is now left in circuit. In order to prevent interference with transmission, the winding was increased from 80 to 1,000 ohms. Independent telephone manufacturers have universally adopted 1,000-ohm bells. The generator was bridged across the circuit, and was necessarily the reverse of the shunted generator of the series bell. It was made normally open, and closed its circuit only during the turning of the generator handle.

The line circuit terminates at the office in the multiple jacks, and the bridging drop LD. This drop has two windings, one about 600 ohms, and the other fifty ohms. The 600-ohm winding is necessarily the bridged winding, and is permanently legged across the circuit. This winding controls the armature, whose attraction releases the catch that normally retains the drop shutter. The ordinary drop shutter falls entirely out of the reach of the magnetism of the restoring winding, so the shutter is made of aluminum, and made dependent upon the position of an armature, which is acted upon by the restoring winding. The armature can only fall a limited distance, in order to remain within the attractive force of the fifty-ohm winding. The number of the drop is painted upon the armature face, and normally is concealed by the aluminum shutter. When the alternating current acts on the 600-ohm winding, the armature of the fifty-ohm winding falls away from the core, and tilts the shutter, which exposes the number on the face.

The jack consists of three contacts, called tip, ring and sleeve by some manufacturers, and tip, sleeve and body, or thimble, by others. The tip and ring contacts are spring contacts, and are connected to each side of the talking circuit. The sleeve is connected to the restoring winding of the drop, and thence to ground, or common battery connection. The original system did not have a jack as simple as this. It was arranged so that the entrance of the plug short-circuited springs, which placed battery through the restoring winding, and put a busy test upon the sleeve. In the system under discussion, the same results are obtained by the entrance of the plug, only that the battery for restoration is carried on the sleeve of the plug. It is shown in this

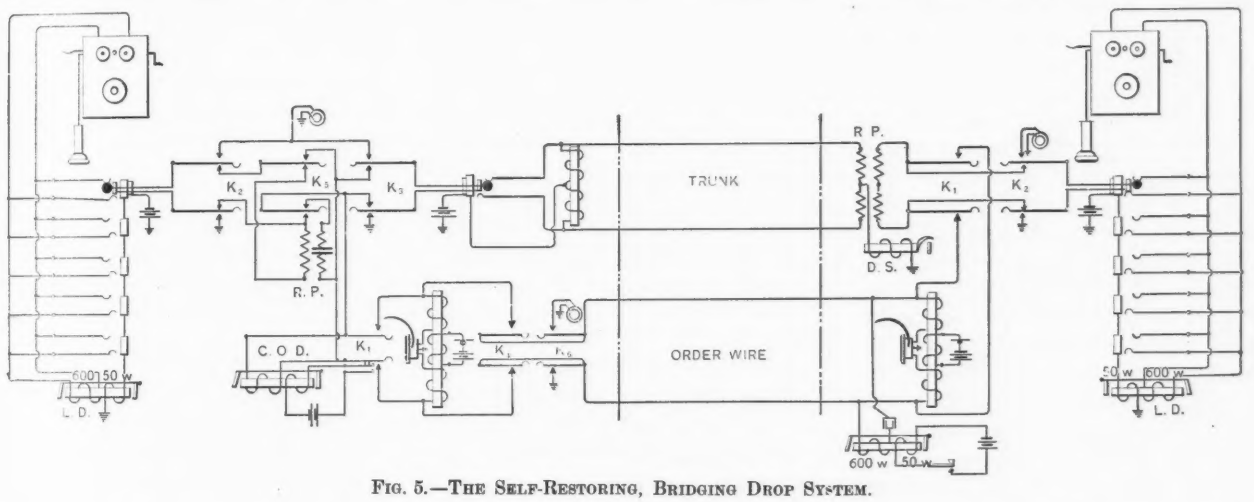


FIG. 5.—THE SELF-RESTORING, BRIDGING DROP SYSTEM.

way, in order to more clearly show the close connecting link between this system and the common battery systems, where the repeating coil is used in the cord circuit.

In any multiple system it is necessary to cut off the line signal, or render it inoperative, when on cord connection. The cut-off jack was used in the series system, and it caused trouble from the uncertain series contacts of the jacks. In this system it is not necessary to cut off the jack for talking purposes, because of its high impedance. It is necessary to keep the drop shutter from falling, to prevent operating confusion, and this is done by the winding, which not only acts as a restoring winding, but acts as a falling preventative winding. As long as the plug is inserted, the drop is inoperative, as regards its usual functions.

The cord circuit consists of ringing keys K2 and K3, a repeating coil key K5, and a listening key K1. There is also an order key K4, in common with the operator's set. It bridges the operator's set on the order line, for communication with an operator in an adjacent office. If the number of metallic lines predominate, the repeating coil key, in its normal position, makes the cord circuit purely metallic. If the operator wishes to connect a grounded line to a metallic line, she throws the cam of the key K5, which puts the cords and plugs of the circuit in inductive relation with each other. This serves to keep the system balanced. As the sleeve of the plug is separated from the talking circuit, the operation of the repeating coil key has no effect. It has at all times a negative potential of eight volts existing, which when it comes into contact with the sleeve of the jack either restores the line drop or locks it. When the operator answers the party, she throws the cam of listening key, and puts her talking set across the line. When she finds out the number wanted, she inserts the plug into the desired jack, and rings the party. When the parties have finished conversation, and one or the other rings off, the clearing-out drop COD falls. Before the operator pulls down the connection, she has to throw in her talking set and challenge the line. If no one responds, she pulls down the connection. Therefore, the natural place to effect the automatic restoration of this clearing drop was by means of the listening key. On one of the mainsprings of the listening key a pair of insulated springs were attached, so that when the movable springs of the key were thrown against the immovable springs, to make line connection with the listening set, one of the insulated springs came into contact with the other. This caused battery current to flow through the restoring winding, and thereby restored it.

The operator can not plug into a jack multiple without testing. The test of the series system can not be used here. There are no grounds at the subscribers' station now. Besides, it was one of the needed improvements that the subscriber engaged in conversation shall not hear the test made. This was easy, as the sleeve of the jack multiple made an excellent test terminal. It was grounded through the restoring winding. So the first requisite of that test was that when the tip of the plug touched ground the receiver would make no sound. When the tip touched a busy jack it came into contact with battery from the sleeve of some other operator's plug. To accomplish this, there was a ground on the operator's receiver circuit somewhere. Now, a ground on a metallic circuit is a serious matter, even though temporarily. It would make the line in connection so noisy that the operator could not tell whether she got a test or not. In the series trunk circuit it was found that a ground could be placed on a metallic circuit, without any evil influence whatever, if it was placed at the centre of a bridged impedance. It is easy to make the induction coil of such an arrangement that its secondary halves equally. It is also a simple matter to halve the receiver. Therefore, to put a ground on a metallic circuit, through an operator's set, it is necessary to split the induction coil and the receiver, which was done, as seen in the figure. The battery from a busy jack flows through one-half of the receiver and secondary, and gives the operator decided clicks at each contact between tip of plug and sleeve of jack. Ordinarily, ground meets ground, and no click is heard.

Instead of indicating another party to be called in the same exchange, the figure is intended to show a call for a party in a distant adjacent office. For this reason the order wire is shown, terminating in the talking set of an operator in the adjacent exchange, whom we shall call B. The ring-down key K6 is shown, and also the drop on the B end of the order circuit. At night the business of the system can not afford a B operator, so one operator may have to handle all of the traffic. It is therefore necessary that some means is given whereby the B operator may be called during the night, so that a connection may be completed between the two offices. The A operator holds her order button down, and by means of the ring-down key sends an alternating current over the trunk line. It throws down the shutter of the bridged drop, which causes some local contacts to close a generator circuit through the night bell, not shown, which alarms the operator at B office, who proceeds to hunt for the fallen drop. Discovering it to be a trunk call, she takes the order from A, rings the party, and presses a button, which closes the circuit of the restoring winding of the ring-down drop, opens the contacts of the night bell circuit, stopping the ringing. More correctly, she would stop the night bell first.

Practically, there is always instant verbal communication with the B operator. According to the figure, after A finds out that a B call is desired, she gives B the order over the order wire. Operator B instantly assigns a trunk, tests for a busy line, exactly as the A operator does, inserts her plug and rings the party. The series system had this same method. Common battery systems have this same method. Where then is the improvement? In the common battery systems it will be shown that an improvement does take place to a slight degree in the accomplishment of a connection. But the self-restoring system shows no improvement. As in the series system, neither A nor B knows when the called-for party has answered. Common battery systems show this, and possibly save some needless ringing in talking subscribers' ears, and consequent waste of time in doing so.

Compare now the disconnection of trunk parties. The series system used the magnetic disconnect signal, which notified B when A inserted her plug, and it also notified her when to pull down. The clearing-out drop was removed from the B operator's circuit, to prevent her getting a disconnect from the subscribers, and her temptation to pull down the connection before the originating operator gave the order. The bridging system could do no better, because it had the same difficulty inherent in local battery practice. Disconnection would be fairly quick if each subscriber would remember to ring off. Not that both are needed, but either would agitate the clearing-out drop on the A operator's cord circuit, and cause her to pull down the connection a little more quickly, and allow B to assign the trunk for a new connection.

The trunk circuit shown in the figure shows an impedance used at left, or A end of the trunk, and a repeating coil at B end. The bridged impedance is pref-

erable to the repeating coil, as it is more efficient. A repeating coil is necessary at B on account of grounded parties in the offices, so the repeating coil was combined on purpose for giving a path over the trunk line for the magnetic signal DS. At the A end the sleeve of the multiple jack was not necessary for a busy test, and was used for putting disconnect battery over the trunk line. If the eight-volt restoring battery was not of sufficient strength to energize the magnetic signal, dry cells were added in the circuit between the sleeve of the jacks and the middle of the impedance, of sufficient strength and of proper polarity to correspond with the restoring battery to energize DS.

In toll-board practice, when the toll system is in the same office as the local common battery exchange system and the storage batteries are available for lighting of lamps, the general construction of the boards is such that the drops, particularly the clearing-out drops, are concealed in the interior of the board, and the contacts of the drop so arranged that when the shutter falls a lamp lights. This lamp can be placed on the key-shelf, convenient in position and in sight of the operator. The act of throwing the listening key, to challenge a toll line connection, will cause the drop to be restored and the lamp extinguished. This adds a factor of quiet to the office.

The great disadvantage of the restoring system, or commercially known as the branch terminal system, was due to the great size of the drops. This caused them to be mounted high above the multiple, in order to keep the multiple within reaching distance of the operator, as the jacks had to be reached and the drops did not. When a call came in the operator had to look up, locate the number, then the corresponding jack. This was bound to cause lost time. Some of the late common battery boards do not take advantage of the small size of their lamps, and place them over the answering jacks. It is a bad feature, indeed.

The common battery repeating coil system followed, seemingly being suggested, in its main features, by this self-restoring signal system.

Telephonic Communication between England and France.

The English technical papers announce that arrangements have been made for telephonic facilities between a number of large cities of England—including Birmingham, Liverpool, Manchester, Southampton and others—and a number of cities in France, among which may be named Paris, the Paris suburbs, Chartres and Orleans. Service was to be commenced on April 11. The charge has been fixed at eight shillings ($2) for a conversation of three minutes during the day, or, by contract arrangement, for six minutes at night. Service will only be available from post-office call offices or by subscribers to the post-office service.

A Queer and Interesting Old Advertisement.

Only a dozen years after Benjamin Franklin's famous discovery with the use of a kite that lightning is electricity, this advertisement appeared in the Massachusetts *Gazette,* March 7, 1765. What were these "entertaining Experiments" offered to the people of Boston "at one Pistareen a Lecture" by David Mason?

A COURSE OF EXPERIMENTS
ON THE

newly discovered *Electrical Fire,* to be accompanied with methodical LECTURES on the Nature and Properties of that wonderful Element will be exhibited by DAVID MASON, at his House opposite Mr. *Thomas Jackson;* Distiller, near Sudbury-Street.—To consist of two Lectures, at one Pistareen each Lecture.—The first Lectures to be on Monday and Thursday, and the Second on Tuesday and Friday Evenings every week, Weather permitting.

OF ELECTRICITY in general

That the Electric Fire is a real Element,—That our Bodies at all Times contain enough of it to set an House on Fire,—That this Fire will live in Water,—A Representation of the seven Planets, shewing a probable Cause of their keeping their due Distances from each other, and the Sun in the Centre,—The Salute repulsed by the Ladies Fire, or Fire darting from a Lady's Lips, so that she may defy any Person to salute her,—A Battery of Eleven Guns discharged by the Electric Spark, after it has passed through eight Feet of Water,—Several Experiments shewing that the Electric Fire and Lightning are the same, and that Points will draw off the Fire so as to prevent the Stroke,—With a number of other entertaining Experiments, too many to be inserted in an Advertisement.

☞ TICKETS to be had either at his House above or at his Shop in Queen-Street.

Some of the most astute antiquaries at Boston have been making a search for further information respecting the above, since the advertisement was resurrected a short time ago from the files of the Massachusetts *Gazette,* but there has not been any further information on the subject.

The German Society of Electrochemists.

The annual meeting of the Deutsche Bunsen Gesellschaft is to be held this year at Bonn, on the three days May 12 to 14; and the following provisional list of papers has been published by the committee charged with the arrangements for this 1904 meeting of the society:

"The Chemical Mass Action of Toxines"—Professor Arrhenius, Stockholm.

"The Application of the Phase Rule to the Mixture of Iron and Carbon"—Professor Roozeboom, Amsterdam.

"The Catalysis of Cyanogen Compounds"—Professor Bredig, Heidelberg.

"The Determination of the Freezing Point and Conductivity of Urine"—Professor Dreser, Elberfeld.

"Electrochemical Reductions"—Professor Elbs, Giessen.

"The Ruthenberg Electrical Concentration and Reduction Process for Iron Ores"—Dr. H. Goldschmidt, Essen.

"The Hardening of Steel from the Physical Chemist's Standpoint"—Professor Heyn, Charlottenburg.

"Pyrogenic Reaction and Dissociation Phenomena"—Dr. Lob, Bonn.

"The Production, Constitution and Utilization of the Slags Produced in Metallurgical Operations" — Professor Mathesius, Charlottenburg.

"The Passive State of the Metals"—Dr. Wolf-Müller, Mulhausen.

Subject not yet settled—Professor Ostwald, Leipsic.

"The Lead-Tin Alloys"—Dr. Sackur, Berlin.

"The Relation of Kryoscopie to Medical Science"—Dr. Schroeder, Bonn.

"Glass Formation and Devitrification"—Professor Tammann, Göttingen.

Further papers are expected, and as Bonn is one of the most charming and attractive of German university towns, a successful gathering, in point of numbers and interest, is to be expected.

A New Edition of Thompson's Dynamo Electric Machinery.

Messrs. Spon & Chamberlain, 123-125 Liberty street, New York city, are announcing an authorized edition for 1904 of Professor S. P. Thompson's "Dynamo Electric Machinery." Owing to the many changes and improvements which have been made in this branch of electrical engineering during the past eight years, the author has found it necessary to rewrite and greatly enlarge the work to bring it up to present-day practice. The price of this book is now $7.50.

A CONTRIBUTION TO THE STUDY OF THE ELECTRICAL ARC.[1]

BY DR. WILLIAM S. WEEDON.

Arcs may be roughly classified into
1—Crater arcs.
2—Flame arcs.

To the former class belong the plain carbon arc and arcs between certain conductors of the second class, such as zirconium oxide (Rasch arc). To the latter class belong the so-called flame carbon arcs (*e. g.*, Bremer arc), which are drawn from carbons containing certain metallic salts; we also have in this class the arcs from most metals. In the first class the light obtained is derived principally from the two spots or craters, while in the second the arc stream itself furnishes the greater part of the light—generally all. This second class offers by far more interesting study, since we are able to follow the changes in the character of the light as we alter our conditions.

Only direct-current arcs are considered in this paper, the source of current being a 500-volt generator, and in some cases the Edison three-wire circuit for 125 and 250 volts.

The relations between voltage, current and arc length are fairly well known, but for the sake of illustration I have given two sets of curves for the iron arc, and in general form these curves apply to both classes of arcs. The measurements are across the arc terminals. (Figs. 1 and 2.)

One of the most important problems in connection with the arc is with reference to the amount of material which is transported during the running of the arc. In the air, for most materials, this is quite large. The rate of waste of carbon is diminished by running "enclosed," or in an atmosphere of carbon monoxide. The question is, how much material is necessarily transported at given current density, voltage and arc length? Is there any law for arcs corresponding to Faraday's law for solution?

First of all, it is evident that the heat conductivity of the electrode is an important consideration, as it is plain to one who is at all familiar with the arc that there is much more material volatilized by heat than is necessary to furnish material for the active part of the arc.

COPPER ARC IN AIR.

The following experiments will give a good idea of the relation between the number of amperes used and the rate of waste, and also show the tendency for the anode to gain in weight rather than lose. (Fig. 3.)

Two arcs were run in series, both being vertical in order to obtain conditions as uniform as possible. Only the lower electrodes are weighed. In both arcs the electrodes were one-quarter inch in diameter; arc length, one-eighth inch; time of

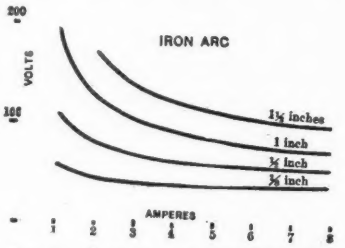


FIG. 1. CURVES FOR THE IRON ARC.

running, two hours, at two amperes, forty-five volts.

	Cathode. Grammes.	Anode. Grammes.
Weight before running..	20.610	20.821
Weight after running...	20.288	20.833
Loss	0.322	
Gain		0.012

Upon increasing the current to five amperes at thirty-five volts (same arc length)

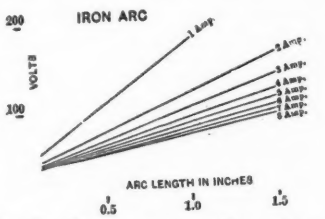


FIG. 2.—CURVES FOR THE IRON ARC.

and running for two hours, the result was as follows:

	Cathode. Grammes.	Anode. Grammes.
Weight before running..	20.247	20.764
Weight after running...	18.462	20.833
Loss	1.785	
Gain		0.069

In the latter experiment, the current used is 2.5 times as large as in the first

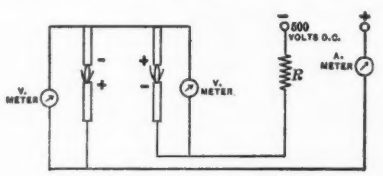


FIG. 3.—COPPER ARC IN AIR.

experiment, but the loss in weight of the cathode is more than five times as great.

A fact to be noted here is the tendency for the heavy, outer mantle of the copper arc to appear only occasionally when the current is low. This is undoubtedly connected with oxidation, and the same phenomenon is to be seen in iron arcs. In Fig. 4 *a* the arc is shown with the outer mantle invisible; when the outer mantle flashes, it appears to come from the cathode, as is represented in *b* and *c*.

Cooling the electrodes was then tried, the arrangement being as before. The lower electrodes, however, which were weighed, had the form of a copper shell, three-quarters inch in diameter, one and one-quarter inches long, and one sixty-fourth inch thick. The upper electrodes were the same as before. Water was sent in a jet against the tip, as shown in Fig. 5.

While the arc was running, the lower electrodes could be touched very close to the arc without any sensation of warmth being experienced. The result of several experiments is as follows:

Time, one and one-half hours; current, two amperes; volts, fifty. The arc length was somewhat more than one-eighth inch, as it was found that with one-eighth-inch arc an arc of rather different color—purplish—was obtained in the case where the cathode was cooled. Under these conditions, neither electrode lost in weight, and the gain was apparently due to oxidation.

	Cathode. Grammes.	Anode. Grammes.
Weight before running..	13.014	12.649
Weight after running...	13.018	12.672
Gain	0.004	0.023

In order to determine the actual loss of the cathode it was reduced in hydrogen, and the real loss found to be 0.013 gramme. It is to be seen from this that the Faraday equivalent, if one exists, does not apply to arcs as it does to solutions, since by this amount of current, 450 times the amount of copper should have been transferred.

In order to overcome the influence due to oxidation, it was determined to run an arc in nitrogen between copper electrodes. The general results, however, were exactly the same as when the arc was run in air, and it appears that the copper and nitrogen undergo combination under these conditions. The arrangement used is shown in Fig. 6.

The gas was generated in the usual way from sodium nitrate and ammonium chloride, and purified by passing through aqueous potash and concentrated sulphuric acid.

COPPER ARC IN HYDROGEN.

In some preliminary experiments, the vertical arc was used with cathode below, the electrodes being solid one-quarter-inch copper rods. With the 500-volt circuit only a short arc could be drawn, and the cathode was found to lose in weight, while the positive electrode

[1] A paper read at the fifth general meeting of the American Electrochemical Society, at Washington, D. C., April 9, 1904.

gained. By varying the arc length and current three distinct kinds of arc were obtained.

1—When the electrodes are cold, at the starting of the arc, with about 1,300 ohms in series, there occurs momentarily a discharge giving a pink glow, which soon changes to one of the arcs described below. The spectroscope shows strong hydrogen lines.

2—An arc of about one-eighth inch in length, current 0.5 ampere, voltage about 300. The arc is non-luminous, shows both copper and hydrogen lines to a slight extent. There is a faint glow around the positive electrode, arranged in transverse striations. The negative electrode is hotter than the positive, and the discharge is irregular, seeming to come from a small point on the positive to a much larger and brighter spot on the negative electrode.

3—While arc No. 2 is being run, if the series resistance is decreased by about 100 ohms, at a critical point, a green copper arc suddenly appears. Hydrogen lines, as well as copper lines, may be seen, but frequently only the copper can be detected.

The voltage has dropped from 300 to about 70 during this change, and the current rises to four amperes. The discharge is quite irregular.

A single bulb was used for these arcs, the arc being arranged as was shown in the case of the copper arc in nitrogen. (Fig. 6.)

A curious phenomenon was observed here, and in order better to study it the arc was placed horizontally. The two electrodes were of the same size, held by adapters. The negative was seen to be much hotter than the positive electrode and soon became molten over the tip. While the arc was running, nothing peculiar was observed, but as soon as the circuit was broken, or when the arc went out of its own accord, the molten copper swelled suddenly to two or three times its normal size. It often happened that, when the arc went out of its own accord, the space between the electrodes was bridged over and the arc started anew, the phenomenon occurring many times. It appears that this is due to absorption of hydrogen, which is given off at the temperature of the arc.

Water-cooled electrodes were now tried, a single horizontal arc being used and arranged as shown in Fig. 7.

The bulb was about eight inches long by six inches in diameter, with the main tubes one inch in diameter. The arc was drawn by pushing the stoppers in the tubes and then withdrawing them. In this experiment, the current used was only 0.35 ampere; the arc length was quite short, one-thirty-second inch or less, and the character of the arc was not allowed to change from the non-luminous arc

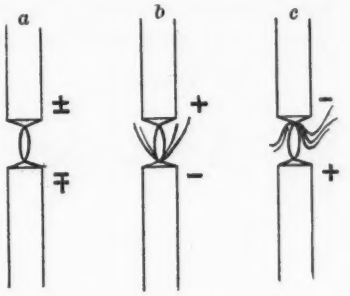


FIG. 4.—COPPER ARC, WITH OUTER MANTLE INVISIBLE.

above described as arc No. 2. The time of running was one and one-half hours.

	Cathode. Grammes.	Anode. Grammes.
Weight before running..	12.657	12.185
Weight after running...	12.653	12.189
Loss	0.004	
Gain		0.004

Although the loss and gain in weight

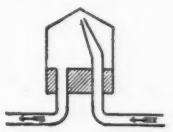


FIG. 5.—WATER-COOLED ELECTRODE.

is very small, and the experimental error possibly large, it is certain that we have obtained a smaller loss than ever before, and if the figures are within any degree accurate there is transferred only about 1/1500 of a Faraday equivalent for solution. The spot upon the cathode was

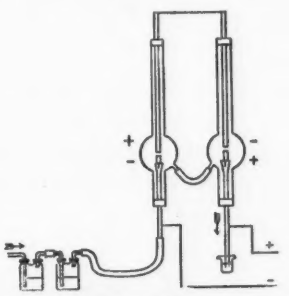


FIG. 6.—ARC IN NITROGEN, BETWEEN COPPER ELECTRODES.

in this case also larger and brighter than upon the anode.

Arons[1] attempted to obtain the copper arc in hydrogen with electrodes separated 0.1 millimetre. He used only 106 volts, however, and consequently was unable to obtain an arc. He also states that at sixty-five millimetres pressure he had considerable difficulty in obtaining a discharge between iron electrodes in hydrogen. This was therefore tried with the 500-volt circuit, and under the same conditions previously given for the copper arc.

[1] Annalen der Physik, 1900, 713.

IRON ARC IN HYDROGEN.

When solid iron rods are used, the same pink light, described under copper arcs, was obtained. This changed almost immediately to a high voltage, non-luminous arc discharge, but it was impossible to obtain a true iron arc before the electrodes were completely melted down.

Water-cooled shells were employed, as described for the copper arc. The arc was run three hours, with current 0.35 ampere, voltage about 300. The spot upon the cathode was larger than that on the anode. Apparently the running of the arc under these conditions is not perfectly simple, and it seems probable that some combination with hydrogen takes place; the iron blackened around the large spot on the cathode, and beyond this, and also on the anode, there appeared curious bronze-like colorations. In several experiments, run under the above conditions, the anode lost in weight and the cathode gained. This amount varied from 0.003 to 0.005 gramme, according to the circulation of the water. Low as these changes in weight are, I feel sure that the experimental error is not large enough to allow the possibility of the change in weight being in the other direction.

CARBON ARC IN HYDROGEN.

Carbons one-quarter inch in diameter were used, the arc being placed horizontally, and the electrodes being held by adapters. At two amperes an arc three-sixteenths inch in length registered 180 volts. The light was not brilliant, the arc stream itself being non-luminous and appearing as a fine line connecting the two electrodes. (Fig. 8.)

The temperature of the two electrodes seemed to be about the same, nor could it be said with certainty that any difference in size of the two craters was noticeable. The presence of acetylene or hydrocarbons of the acetylene series was shown by passing the exhaust hydrogen through an ammoniacal solution of cuprous chloride. A very slight brown precipitate was formed. The arc was run for two hours, and the result was as follows:

	Cathode. Grammes.	Anode. Grammes.
Weight before running....	3.513	3.405
Weight after running.....	3.440	3.278
Loss	0.073	0.127

Under the microscope, the negative

after running showed its surface to be covered with small pits, which were distributed with fair regularity, while the positive showed larger depressions distributed with less regularity. The spectrum observed was a combination of the enclosed arc spectrum and the hydrogen spectrum.

It seems that oxidation, or combination with the surrounding gas, is not absolutely necessary for the production of a luminous arc, but such combination facilitates its formation. This was further confirmed by some experiments made with metallic chromium at one millimetre air pressure. At low current a Geissler discharge was obtained, but at higher current the true chromium arc appeared.

With regard to the amount of material fed to the arc it may be said that there is apparently a tendency for the arc to ionize the surrounding atmosphere if there is not enough material vaporized from the electrode. If much heat is developed, more is vaporized than is employed in transporting the current. Between these two extremes both the atmosphere and the electrode vapor are ionized. We can therefore hardly make measurements which will give us figures comparable to Faraday equivalents. It would appear from this that there is a slow gradation from the spark discharge to the true arc, passing through the intermediate stage where both kinds of discharge are present. The main distinction, therefore, between the arc and the spark discharge is, that in the former vaporized material from the electrode or electrodes undergoes most of the ionization which takes place, while in the latter the surrounding atmosphere suffers most of the ionization. Undoubtedly, as Professor J. J. Thomson observes, in the arc discharge the terminals are incandescent, while such is not the case in a spark discharge; but it appears to the writer to be more a question of securing sufficient material vaporized from the electrodes (by heat or by current direction) which vapor can be ionized; for there is undoubtedly an extremely small quantity of the material transferred by the current itself.

In this we assume that when the copper spectrum appears, copper is undergoing ionization, and that when the hydrogen spectrum appears, hydrogen is undergoing ionization. This will be discussed later.

STRUCTURE OF ARCS.

The structure of metallic arcs in air is in general, as follows:

The very middle path is not luminous, but the light is derived from the outer mantle, and most frequently from that portion of the outer mantle next the inner path, as represented above. In the carbon arc the outer mantle is not well defined, owing to the fact that the product of combustion is gaseous.

It seems probable that the inner nonluminous path above mentioned is in a way comparable to the Crookes dark space.

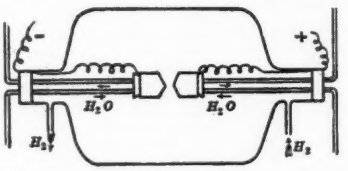


FIG. 7.—WATER-COOLED ELECTRODES.

The explanation given for the presence of the latter is that the large number of negative ions present have too great a velocity to ionize the atoms with which they collide, but that farther along the tube, when their force has been diminished by collision, ionization may take place. Where this occurs light is given off. (Fig. 9.)

In the arc, the inner path may be caused by the fact that the negative ions in very great numbers are moving rapidly toward the anode, and producing ionization only where their force has been sufficiently diminished by collision, *viz.*, on the sides of the inner path.

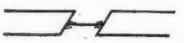


FIG. 8.—CARBON ARC IN HYDROGEN.

There are many changes in the character of an arc during running which are very subtle and of rather obscure origin. In many instances the material depositing on one or both electrodes causes difficulty, and in many instances irregularity in the composition of the material used causes unexpected alterations in the structure of the arc.

DOES THE CATHODE DETERMINE THE CHARACTER OF THE ARC?

In studying the characteristics of the arc, the first fact which one is apt to discover is that the light given off by an arc is not produced by simple heating of particles present in the arc. The opinion was held by the writer for some time, and arrived at after a number of experiments on metallic arcs, that the cathode determines the character of the arc. But here (as in a number of other experiences in the study of the arc) some incorrigible facts appeared just as the opinion was well established, and made the generalization impossible.

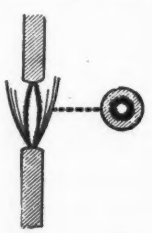


FIG. 9.—STRUCTURE OF METALLIC ARC.

There are cases in which the cathode does not appear to be the determining feature. For instance, two very clear and conflicting cases are as follows:

Copper cathode and magnetic anode give copper arc.

Magnetite cathode and copper anode give iron arc.

Here the cathode undoubtedly determines the nature of the arc.

Copper cathode and thorium carbide anode give thorium arc.

Thorium carbide cathode and copper anode give copper arc. Here we have the anode giving character to the arc.

Besides these contradictory cases, we have such substances as tungsten, calcium carbide and zirconium carbide, acting almost as well in one direction as in the other when copper is used as the second electrode. The conditions for the above experiments were in each case as follows: diameter of electrode, one-half inch; arc length, one inch; current, three amperes; voltage, about 100. It is well to give exact conditions in these experiments, as some arcs do not behave the same under conditions which are varied only slightly. This may be illustrated by the magnetite copper arc above described. A vertical arc is used with the magnetite as cathode below. Under the conditions above given with regard to current and arc length, no copper appears in the arc at all. This is true, apparently, at all current strengths tried, from one ampere to fifteen amperes. It does not seem to hold, however, below one-half ampere. If we start with three amperes for a one-inch arc and gradually reduce the current by throwing in external resistance, the arc changes, as is shown. (Fig. 10.)

When the current reaches one-half ampere, however, the character of the arc suddenly changes, and instead of a pure iron arc we have one in which the copper is shown clearly around the anode. (Fig. 11.)

Whether we are bordering upon the phenomena of spark discharge here or not, the arc characteristics certainly seem to be changed. Reduction in the supply of cathode material seems to be the most important factor. The copper appears to take a part in the ionization when the iron fails to be produced in quantity sufficient to feed the arc. The same phenom-

ena above described may be seen if the copper as cathode is placed below, with the magnetite above. At low current the iron flashes out, and the spectrum of the upper portion is that of iron, while the lower portion is purely copper.

The position of the electrode materially alters the character of the arc. If an arc is drawn between two terminals of different composition, and the arc belongs to the class in which the cathode, rather than the anode, determines the arc characteristics, the arc flame is naturally fed more uniformly if the cathode is below. We then obtain the arc of clean-cut characteristics, showing generally the spectrum of the cathode only, and possessing a well-defined structure, composed of an inner path, the intermediate luminous path and the outer mantle, which may possess more or less luminosity. If the cathode be placed above, we have the material composing the cathode fed to the arc rather badly, for it does not extend, as a rule, completely across this space to the anode (one-inch arc being used). As a result, the upper portion of the arc possesses strongly one set of characteristics, while the lower portion partakes, to a greater or less extent, of the properties of the anode.

It certainly can not be said that the cathode always determines the nature of the arc. There seems rather to be a kind of selective action taking place, some substances being ionized in preference to others. This is strongly brought out by a study which is at present being made in this laboratory of electrode mixtures. It is certainly true that metallic salts are ionized very readily in the arc, and the presence of carbon also has a peculiar effect. It is to be especially noted here that this ease of ionization does not depend altogether upon the volatility, nor even upon the mere presence of the vapor of the substance in the arc. The direction of the current may determine it in a given instance. If we take the example already used, of copper-magnetite with magnetite as anode below, the copper is certainly at a lower temperature than when the current is reversed, yet the arc is entirely a copper arc. No iron appears in the arc or its spectrum, even though the current is raised to fifteen amperes, and the magnetite is boiling so strongly that the arc must be filled with its vapor. Why is not the vapor ionized, giving the iron arc? Why do not even the heated particles give off light?

In trying to gain some conception of what takes place in the arc, we must go back to the study of the distribution of potential in the arc stream. The potential gradient is about as shown in Fig. 12.

We ought also to have some conception of the process of ionization in the arc, and for this purpose I quote the views of Professor J. J. Thomson, which were given in his lectures at the Johns Hopkins University last June.[1]

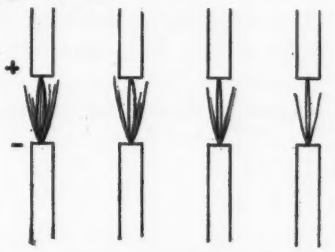


FIG. 10.—ARC CHANGES, WITH CHANGE OF CURRENT.

"On this view the cathode is bombarded by the positive ions which maintain its temperature at such a high value that negative corpuscles come out of the cathode; these, which carry by far the larger part of the arc discharge, bombard the anode and keep it at incandescence, they also ionize, either directly by

FIG. 11.—COPPER ARC AT ANODE.

collision or indirectly by heating the anode, the gas or vapor of the metal of which the anode is made, producing in this way the supply of positive ions which keep the cathode hot. It will be seen that the essential feature in the discharge is the hot cathode, as this has to supply the carriers of the greater part of the

FIG. 12.—DISTRIBUTION OF POTENTIAL IN ARC STREAM.

current in the arc; the anode has in general to be hot, otherwise it could not supply the positive ions which keep the cathode hot."

Professor Thomson also gave as his opinion that the positive ions would ordinarily act as the principal current carriers, were the distribution of potential more regular; for there is generally more heat developed at the anode than at the cathode. The sharp drop of potential at the anode, however, acts as a barrier in the path of the positive ion.

It would appear from this that if this sharp drop of potential could be eliminated that the positive ions would lend character to the arc, as well as the negative ions. We should then have the character of the anode influencing the nature of the arc to a great extent. In order to test this, a large number of experiments were made, and the general results will be given.

Under certain conditions arcs have a tendency to hiss, and this is accompanied by several phenomena which are very interesting. In the first case, there is a diminution in voltage across the arc, and this generally amounts to about ten volts, whatever the character of the arc. It has been shown that these ten volts are lost principally by that portion of the arc next to the anode.[1]

From this it would seem that a hissing arc might offer a chance to test the idea advanced by Professor Thomson, and some of our experiments seem to confirm the supposition, although it is difficult to obtain a case which is clearly defined.

The magnetite-copper arc is one of the clearest cases known. The copper, as cathode, is placed below. As has been frequently stated, the arc is distinctively a copper arc—under normal conditions. Hissing occasionally takes place, however (the noise is not a prominent feature except in carbon arcs), and a bright jet of flame appears at the anode. This flame is due to iron, as is shown by the spectroscope and by the color. The arc voltage was decreased by ten volts during hissing, and an exploring rod of iron showed that these ten volts were lost, for the most part at least, at the surface of the anode.

In this case, at least, it would appear that during hissing the positive ions may carry a large part of the current, due to the lack of the potential barrier, which is present in normal arcs. The electrodes in the above experiment had a diameter of from one-quarter inch to three-quarters inch, while the current varied from three to seven amperes; arc length, one-quarter inch to one inch.

Here, again, however, we are thrown somewhat in doubt, as this bright jet of flame from the anode often occurs when there is no drop of potential at all. This frequently occurs with such substances as ferromanganese, which are capable of

[1] See "Conduction of Electricity through Gases," by Professor J. J. Thomson, p. 424.

[1] Luggin, Wien, Sitz, 96, 1,192. Ayrton, "The Electric Arc," p. 310.

ready oxidation. Nevertheless, whenever this drop of ten volts occurs the characteristics of the anode appear. We are forced to the conclusion that if the assumptions we have made are correct, there are times when the potential barrier, mentioned by Professor Thomson, is not sufficient to hold the positive ions in check. This may be assumed also for those arcs in which the characteristics of the anode appear when running under normal conditions.

At any rate, it may be seen that the character of the light is not determined simply by the heated particles present in the arc. There certainly may be heated particles present which are not active in giving off light. It does not appear altogether out of the question to associate the light derived from the cathode with negatively electrified particles, and that derived from the anode with positively electrified particles. There seems no necessity for making a more complicated assumption, although we must admit that one may be possible. It is perfectly conceivable, for instance, that under certain circumstances the vapor from the anode may be ionized by negative ions, and consequently, should be associated with the latter.[1] The experiments above recorded with reference to the magnetite-copper arc do not seem to be in accord with this view, however.

Joint Meeting of British and American Mechanical Engineers.

The Chicago meeting, beginning on the evening of Tuesday, May 31, and probably ending on Friday, June 3, is to be a joint session of the American Society of Mechanical Engineers and the Institution of Mechanical Engineers, of Great Britain. Nearly two hundred members of the British institution have expressed their intention of coming to America and taking part in this joint meeting. It is the purpose of these visitors not only to attend an American meeting and thereafter visit the St. Louis Exposition, but to make the American visit the occasion of excursions to points of technical and manufacturing interests all through the United States. Among the subjects of papers to be presented at the Chicago meeting by the British institution will be the steam turbine, the gas engine, motor cars, hydraulic and electric cranes, induction fans and garbage destructors. The committee on meetings has decided to ask for papers on the American steam turbine, American gas engine, the power plant of the tall office building, the American locomotive testing plant, the American shop management problem, the modern American machine tool, and one or two others. Pursuant to this policy it will not ask for contributed papers from the members on any other subjects than these, with a view to limiting the number of papers to be read and giving the greatest available time for extended discussion. It is hoped that the papers from the British society may be distributed with the American papers to members of the American society.

[1] Townsend, *Phil. Mag.* (6)-1-p. 198 (1901), 3-p. 559 (1902). Townsend, *Nature*, 62 Aug.-1900-p. 340. Townsend and Kirkby, *Phil. Mag.* (6)-1-p. 630-(1901).

DISSOCIATION BY MEANS OF THE ALTERNATING ELECTRIC CURRENT.[1]

BY WILLIAM H. DAVIS.

In presenting this paper I shall make no effort to discuss the subject-matter from a theoretical point of view; this will be left to those who are better fitted for the work.

It would be a matter of pleasure and satisfaction to me if the results were confirmed by others, and I shall therefore endeavor to present the history of the experiment in such a manner that any one who wishes may repeat it, and, I trust, prove that work may be done upon a solution by an electric current, although this is opposed to the theory of Arrhenius, as held by some workers at the present time.

In the early spring of 1902 I began a series of experiments in the cyanide plant of the Smuggler-Union Mining Company, at Telluride, Col., in hope of perfecting a method of recovery of cyanogen from the double salts of a cyanide solution. A chemical process seemed out of the field of profit, owing to the solubility of the simple cyanides in excess of potassium-cyanide. The solution had either to be rendered acid or an excess of the precipitant added, and there being no cheap precipitant of the cyanogen, it was decided to turn to electrochemical investigation.

A direct current was first employed and it was soon found that a division of the compound sought (KCN) was the result, and that correction could not be made by placing the anode in a porous cup, for the alkali and acid radicals were constantly being separated by the current effect; therefore, if a solution of alkali, say caustic soda, was contained in the porous cup the sodium radical would pass out proportional to the entering cyanogen, and if an excess of caustic soda was maintained, even by washing the anode, a polymerization of the cyanogen would occur in sufficient amount to make the process valueless for the work at hand.

[1] A paper read by title at the fifth general meeting of the American Electrochemical Society, at Washington, D. C., April 9, 1904.

The direct current having been found ineffectual, attention was turned to the alternating current. It was at once noticed that the desired results were obtained together with precipitation of the basic metals when an excess of free alkali was present. The determinations were made by the usual Liebig method ($AgNO_3$) and it was found that by no other known method could the cyanide content be raised higher. In the case of foul solutions the cyanide was in many cases raised one-half of one per cent. For final results I will refer those interested to the report of the director of the mint, upon the production of the precious metals in the United States during the calendar year 1903, pages 99 to 101, to be had from the director of the mint at Washington.

These results lead up to the consideration of the theoretical side, and in the study it was found that an alternating current would raise the osmotic pressure of a solution concentrated so that complete dissociation was not present.

The experiment was conducted in the following manner: a porous cup holding about 200 cubic centimetres was rendered semi-permeable with copper ferrocyanide and the walls so adjusted that the cup would maintain a hydrostatic pressure of one centimetre above the water level outside the cup (several trials were made before this adjustment was reached). A rubber stopper with two holes was then placed securely in the cup, through one of which holes a glass tube was inserted, one square millimetre in cross-section, reaching within one millimetre of the bottom of the cup, and through the other hole another tube was inserted reaching only to the bottom of the stopper; the whole was then sealed with sealing-wax and placed in a beaker of distilled water, wires of platinum were placed in the tubes, which served as electrodes, and these were connected to a switchboard. Through the tube reaching to the bottom of the cup a ten per cent solution of sodiumacetate was led into the cup until the height in the tubes indicated ten centimetres above the water level outside the cup, and then the apparatus was allowed to stand for twenty-four hours. At the end of this time the solution stood one centimetre above the water level, and then two amperes of alternating current were sent through the solution. No changes were made excepting to close the switch. In five seconds the solution rose to five centimetres and would not go higher during the next thirty seconds. The current was then turned off and the solution fell to the initial height in about twenty minutes. The current was again turned on and the same results followed, and this was gone through with perhaps twenty times during the week or ten days following.

The current was from a three-phase generator of the usual type, working at sixty cycles per second; one leg of the circuit was used and the current was controlled by a bank of incandescent lamps connected in multiple.

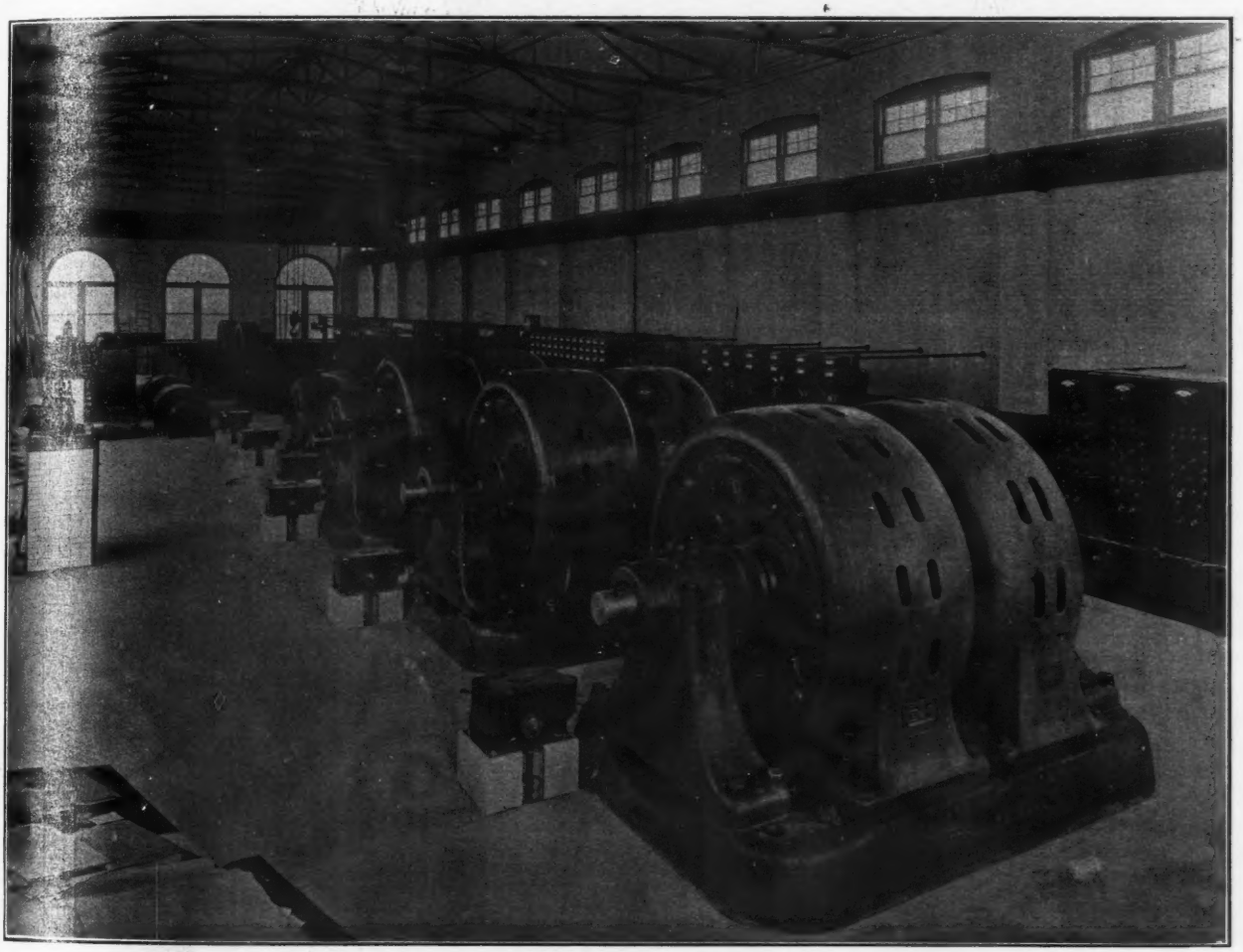
The New Dock Street Substation of the Schenectady Railway Company, Schenectady, N. Y.

THE rapid growth of the system of the Schenectady Railway Company has made it necessary in the past to take care of the expansion by adding units to an original steam plant which was able to provide for but a very small part of the present load. During the past three years the company has built and equipped several splendid substations, notably at Albany, Troy and Ballston, but its main substation has consisted of a remarkably heterogeneous collection of apparatus which has sometimes been loaded to dangerous points.

Originally, the Schenectady Railway Company's main generating station contained a few engine-driven units; but, with the advent of power from the General Electric Company's works at Schenectady, and from the hydraulic plant at Mechanicville, the old steam plant was shut down, but not dismantled. Supplementary apparatus was installed in the plant in the shape of static transformers and rotary converters for the railway load, and motor-generators for the lighting and power load which was then building up. Arrangements were made to have the high-tension lines connected both from the General Electric Company's plant at Schenectady and the hydraulic plant at Mechanicville, to feed the substations at Albany and Troy. It was long ago recognized, however, that a positive need was a main substation where could be centralized all of the incoming and outgoing feeders. By "incoming feeders" would be meant the high-tension current from the hydraulic plant at Mechanicville and the newly opened plant at Spiers Falls, and the supplementary service from the General Electric Company's works at Schenectady. By "outgoing feeders" would be meant the 10,000-volt feeders to the Albany, Troy and Ballston (new) substations.

Plans were made accordingly for a new station near to the old station on Dock street, and ground was purchased and laid out for a building which would be some 160 feet deep by 45 feet frontage. This is close to the Mohawk canal on one side, and, in the rear, is adjacent to the tracks of the New York Central & Hudson River Railroad.

Work has been progressing rapidly for about two years on this new substation, and, very recently, parts of the installation have been started up, the plant now being in a very fair state of completion. The building is of brick construction throughout, and the chief aim of the designers and engineers has been to make the equipment as substantial as possible. Every known method to avoid the possibility of fire, and all that engineering could suggest to eliminate breakdowns and interruptions to the service, have been utilized. The plant stands to-day a model in every respect. In fact, there is nothing—ex-



INTERIOR OF THE DOCK STREET SUBSTATION OF THE SCHENECTADY RAILWAY COMPANY—MOTOR-GENERATORS, AND INCOMING 10,000-VOLT LINE SWITCH IN FOREGROUND.

cepting, possibly, the insulation on the feeders—which can burn. The roof, which is supported on iron trusses, is of slow-burning mill construction, and this is the only wood which has been used in the building.

Exterior of Dock Street Substation, Schenectady Railway Company.

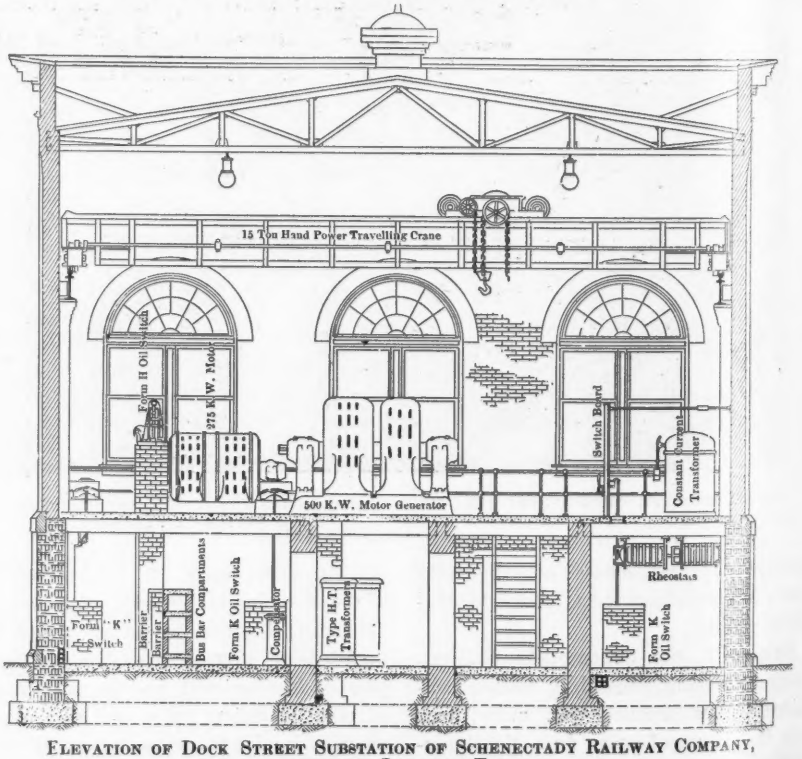
The plant is laid out in two distinct divisions. All of the railway apparatus is concentrated in one half of the building and all of the lighting apparatus is concentrated in the other half. While there is no visible dividing line in the machine room proper, the railway and lighting departments are entirely separated by heavy brick barriers below the surface of the main floor.

Power is delivered to the apparatus through three high-tension lines. This gives a lighting, railway and spare cable. Pressure is delivered from the Spiers Falls and Mechanicville plants to the General Electric Company's works at Schenectady at 30,000 volts. It is here stepped down to 10,000 volts and delivered at this pressure to the new substation. The 10,000-volt leads are joined to form-H oil switches through heavy disconnecting knife-blade switches. From the oil switches the leads are carried on heavy insulators to the bus-bars, each phase being insulated in a separate brick compartment. At some distance from the point of connection of the incoming leads to the bus-bars taps are taken off, connecting the taps through disconnecting knife switches to the primaries of the static transformers which serve the rotary converters. All of the motor-operating mechanism connected with the large form-H oil switches is located on the main floor, the oil-break only, situated in brick compartment, being placed underneath. The connection between the operating mechanism and the oil-breaks is by means of heavy wooden rods.

By means of current and potential transformers, all of the operating current is reduced, so that at the switchboard, with the exception, of course, of the 600-volt direct-current railway service, there is no pressure greater than 125 volts. A storage battery of fifty-five cells furnishes current for operating the motors working the oil switching apparatus.

In order to provide proper ventilation for the static transformers, by closing heavily battened doors this compartment becomes an air chamber. An air-blower, operated by an induction motor, and feeding into this chamber through an automatic damper, supplies a current of air for cooling the transformers. All of the wiring from the switches and for the ammeter and voltmeter leads is carried through conduit laid in the terrazo flooring to the switchboard. The high-tension leads from the oil switches to the motor-generators are transported through the walls in heavy iron conduits, every precaution being made to avoid the possibility of short-circuit and fire.

Sectionalizing switches are placed in each leg of the three-phase circuits, so that any portion of any bus-bar may be made dead, ensuring safety for the repairman if it becomes necessary to investigate any part of the circuit. The bus-bars are so interconnected that either the lighting o railway bars can be thrown on the spare cable, as desired. In this compartment, which is designated as the 10,000-volt railway pit, there is located a compressed-air tank, which is served by a motor-driven air compressor from the floor above, this compressed air being used entirely for cleaning purposes.



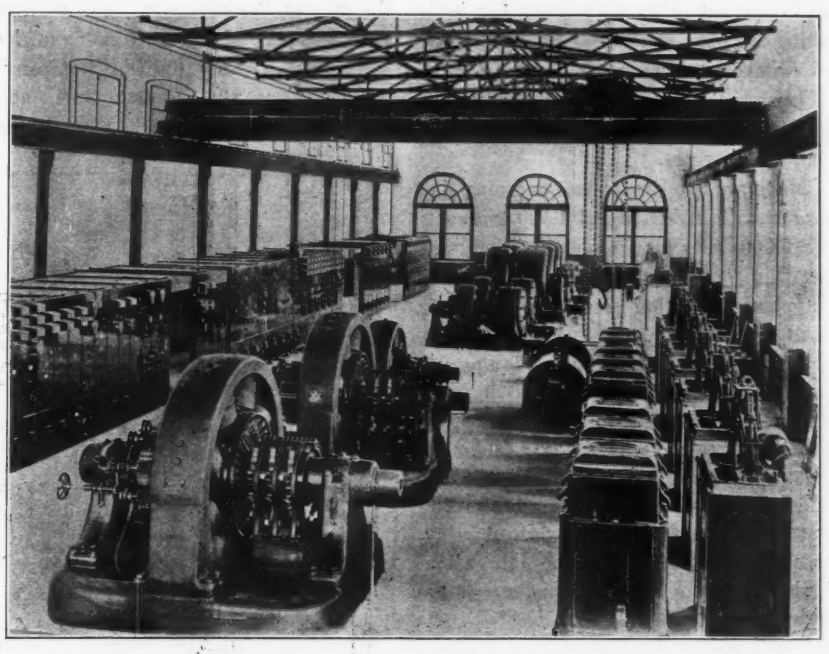
Elevation of Dock Street Substation of Schenectady Railway Company, through Lighting End.

Next to the 10,000-volt railway pit is the machine pit. In this pit are located the leads from the static transformers to the rotary converters, and the negative

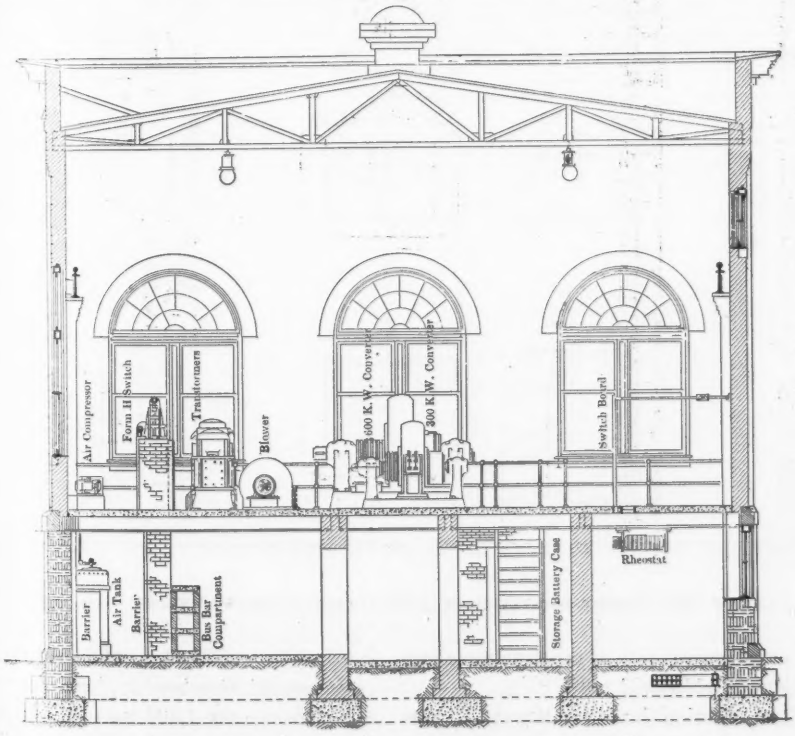
bus-bar for the railway service runs the whole length of this pit.

The lighting compartment, which, as mentioned before, is separated from the railway compartment by a heavy brick barrier, is a continuation of the 10,000-volt railway pit. Here are located the form-K oil switches controlling the motor-generators, and the form-H oil switch controlling the leads for the Rotterdam pumping station, which station is supplied by high-tension current from the Schenectady Railway Company's system. On the east side of the lighting compartment is located the compensating bus, and a General Electric line compensator is installed, with room for future equipment of the same type. The bars for the three phases are located, the same as in the railway pit, in heavy brick compartments, and equipped with sectionalizing knife switches. The other compartments on the lower floor are devoted to the machine pit for lighting service, and directly under the long switchboard is placed the regulating apparatus. At the extreme east side of the building all of the outgoing cables for railway, light and power service are concentrated.

The accompanying illustrations give a good idea of the layout of the machine



INTERIOR OF SUBSTATION OF SCHENECTADY RAILWAY COMPANY—ROTARIES, TRANSFORMERS, AND 10,000-VOLT OIL SWITCH IN FOREGROUND.



ELEVATION OF DOCK STREET SUBSTATION OF SCHENECTADY RAILWAY COMPANY, THROUGH RAILWAY END.

room proper. The present railway equipment consists of two 600 and two 300-kilowatt converters, with room for a future 600-kilowatt converter. On this floor are also placed the static transformers serving the rotaries, and the oil switches controlling the high-tension circuits. There may also be seen the two blower outfits and the very complete switchboard equipment. Each bank of transformers is supplemented by a reactive coil. The transformers are provided with additional leads connected to the middle points of the secondary windings, in order that the rotary converters may be started from the alternating-current side at half voltage, thus cutting down the starting current. In connection with this, an interlocking device has been installed, which makes it impossible to throw on the high-tension current until the half voltage has been cut off. The rotary converters carry the entire railway load, and the lighting and power load is carried by the motor-generator sets. At present there are installed two seventy-five-kilowatt motor-driven exciters, and three 500-kilowatt motor-generators, with room for a future seventy-five-kilowatt motor-driven exciter and a 500-kilowatt motor-generator. As may be seen from the illustration, each of these machines is controlled by form-K oil switches, the switch-operating mechanism being placed alongside the machine, and the break being made in the compartment on the floor below. On the switchboard, in connection with the operating of these oil switches, a pilot light indicates whether the switch has operated and the circuit is dead. Current at 10,000 volts and forty cycles is fed to the motor side of the motor-generators. The current taken off is at 2,300 volts, sixty cycles for lighting and power. The arc lights are served through a bank of tub transformers of fifty-light capacity each. The secondary pressure for the incandescent lamp service is 118 volts.

All of the switchboard panels are of black enameled slate, and the instruments have a marine finish. Each of the three-phase incoming panels has a capacity of 4,000 kilowatts at 10,000 volts, and each

panel contains the following apparatus: one horizontal edgewise ammeter, one horizontal edgewise voltmeter, one double-pull overload relay with lamp for indicating the open and closed position of the oil switches, one controlling switch for the oil switches, together with the necessary current and potential transformers and static dischargers.

There are two three-phase outgoing-line panels, with a capacity of 1,500 kilowatts at 10,000 volts, and each panel contains one horizontal edgewise ammeter, one polyphase induction recording wattmeter (railway pattern), together with relays, controlling switches, indicating lamps and current transformers and static dischargers. Each of the three-phase rotary converter panels is equipped with a power-factor indicator, a horizontal edgewise ammeter and a three-phase induction recording wattmeter, together with overload relay, controlling switches for the oil switch, indicating lamps and secondary transformers.

The lighting of this substation has been carried out with a view of providing against any possible failure of current. The ordinary lighting will consist of twenty-six arc lamps, hung from the roof and suspended from the sides of the building. As an emergency lighting, a number of incandescent lamps will be mounted on the roof girders, and these will be fed from the railway circuit. Should both the railway and lighting circuits fail, a special relay device will automatically switch the storage batteries on the lights, so that there will always be a source of current for the lighting of the station.

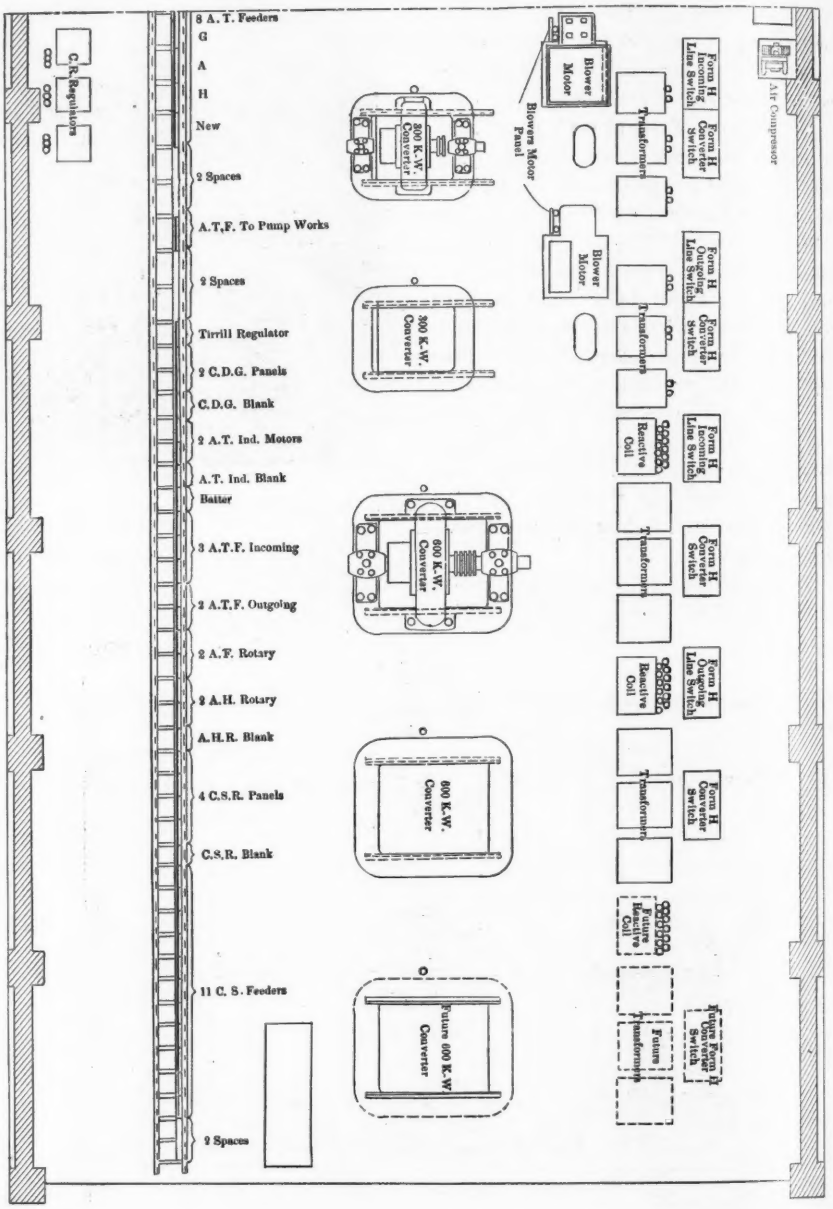
The generator panels of the motor-generator sets are equipped with voltmeters and plug connections for all the three phases of the 2,300-volt lines. These panels are also equipped with synchronizing plugs for the generators. A specially designed synchronizing device is installed for testing the phase relation between the railway and lighting cables. This would be necessary in case it should become expedient to operate both the lighting and power circuits from the same bus-bars.

Both the incoming and outgoing lines are equipped with relay devices, which in the event of a short-circuit or overload act as current transformers, so that as the tension on the secondary increases an armature is pulled over against the tension of a spring, and the oil switches are opened.

The station is served by a fifteen-ton, traveling, hand-operated crane. This makes it possible to lift any large piece of apparatus from a broad archway at the rear of the substation, and transport it to any part of the machine-room floor.

The Schenectady Railway Company is operating, at the present time, about seventy-five miles of track, and there are in an advanced state of construction about thirty-six additional miles.

The lighting load on March 27 was equivalent to 104,820 sixteen-candle-power lamps. There were installed at that time 484 city arcs. The company has installed 5,425 meters, and its motor load is equivalent to 12,180 sixteen-candle-power lamps.



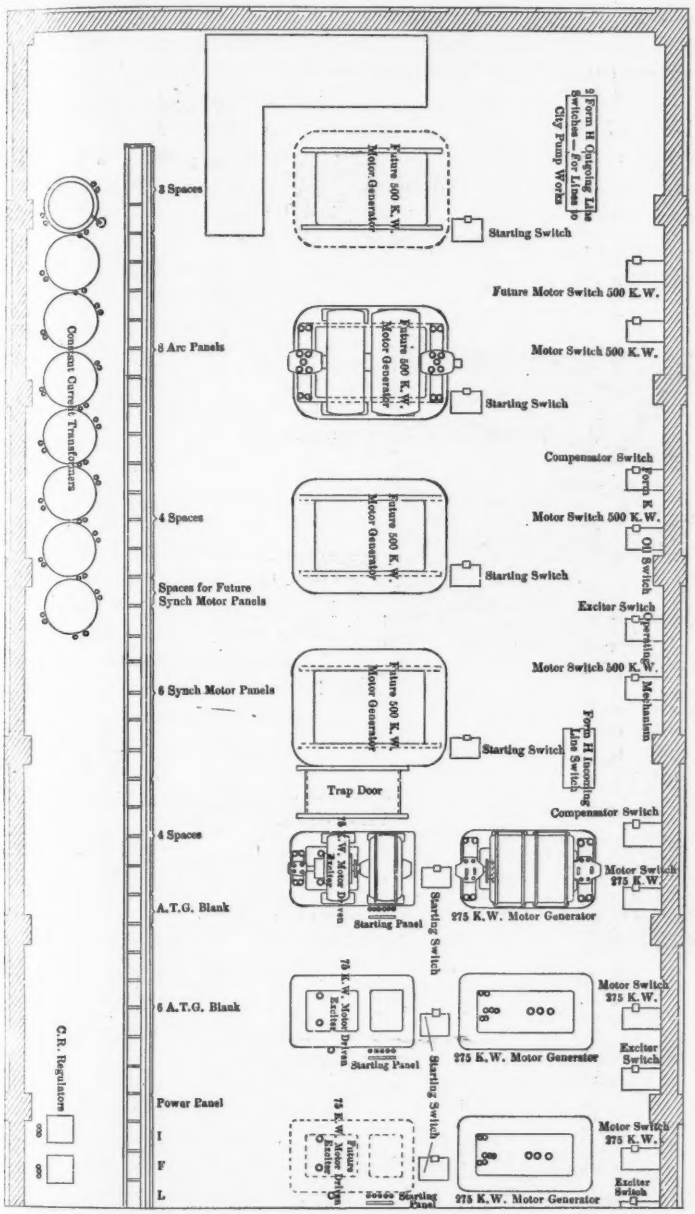
PLAN OF DOCK STREET SUBSTATION OF SCHENECTADY RAILWAY COMPANY, RAILWAY END.

The International Electrical Congress.

The meeting of the congress committee of organization is scheduled for April 23, in New York city, at 1.30 P. M. All of the congress officers have been invited to attend. The meeting will be held at 95 Liberty street, at the offices of the American Institute of Electrical Engineers. Acceptances of membership have been received from over 1,300 up to the present time, and 150 papers have been promised in all.

The following societies have all promised to hold conventions at St. Louis during the congress week, and to hold conventions with one or more sections of the

congress: the American Institute of Electrical Engineers, the American Physical Society, the American Electrochemical Society, the American Electrotherapeutic Association, the International Association of Municipal Electricians. The British Institution of Electrical Engineers has also arranged to cooperate under some plan, the details of which have not yet been determined. The following bodies have promised to cooperate by sending delegates: the Société Internationale des Électriciens, the National Electric Light Association and the Association of Edison Illuminating Companies.



PLAN OF DOCK STREET SUBSTATION OF SCHENECTADY RAILWAY COMPANY, LIGHTING END.

The following papers have been promised for section A, the section on theory, of which Professor E. L. Nichols is chairman and Professor H. T. Barnes is secretary:

Foreign—"Metallic Conduction," Professor Dr. Paul Drude; "Electrical Standards," Professor Dr. W. Jaeger; "Ions," Sir Oliver Lodge; "Magneto-Striction," Professor H. Nagaoka; "The Theory of Ionization by Collision," Professor J. S. Townsend; "Secondary Standards of Lights," M. J. Violle; "Condensation Neuclei," Mr. C. T. R. Wilson; "Magneto-Optics," Professor P. Zeemann. American—"The Mechanical Equivalent of Heat as Measured by Electrical Means," Professor H. T. Barnes; "Atmospheric Neuclei," Dr. Carl Barus; "The State of Our Knowledge Regarding the Earth's Magnetism," Dr. Louis A. Bauer; "Magneto-Optics," Professor D. B. Brace; "The Absolute Value of the Electromotive Force of the Clark and Weston Cells," Professor H. S. Carhart and G. W. Patterson, Jr.; "The Electric Arc," Professor C. D. Child; "Coherer Action," Dr. K. E. Guthe; "Electrical Discharges in Gases," Professor E. P. Lewis; "Electrostriction," Professor L. T. More; "The Unobtained Wave-Lengths between the Longest Thermal and the Shortest Electric Waves yet Measured," Professor E. Fox Nichols; "Standards of Light," Professor E. L. Nichols; "Magnetic Effect of Moving Charges," Harold Pender; "Electrical Theory," Dr. M. I. Pupin; "Alternating-Current Measurements," Dr. Edward B. Rosa; "Radioactive Change," Professor E. Rutherford; "Radioactivity of the Atmosphere," Professor J. C. McLennan; "Electrical Discharge in Gases," Professor J. Trowbridge; "Electrical Theory," Professor A. G. Webster.

The Union Engineering Building.

The conference committee of the union engineering building has draughted a bill incorporating the United Engineering Society, which will hold the property for the several societies involved. This has been introduced in the state senate by Senator Townsend, of Utica. It has already passed both chambers, and is before the governor for signature.

The following firms of architects have been selected by the conference committee, and have consented to join in a limited competition for the plans of the engineering building, as well as the Engineers' Club building: Carrere & Hastings, Clinton & Russell, Whitfield & King, Ackerman & Partridge, Palmer & Hornbostel and Lord & Hewlett. During the absence of Dr. S. S. Wheeler, Mr. Gano S. Dunn has been appointed by the American Institute of Electrical Engineers as its representative in his place on the conference committee. Arrangements have been completed to have Professor W. R. Ware act as professional adviser in the matter of architectural competition.

"*The Aluminum Electrolytic Condenser.*"

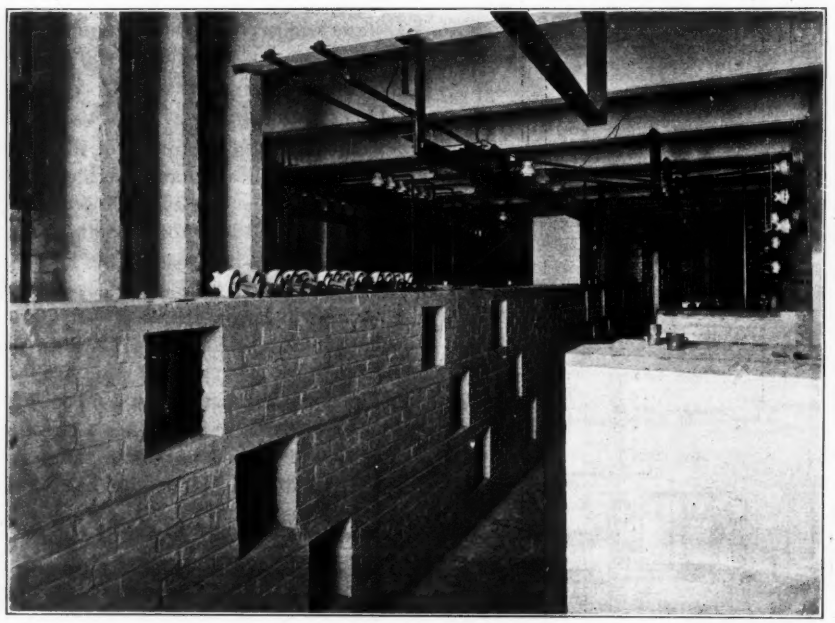
By an unfortunate typographical error, the paper entitled "The Aluminum Electrolytic Condenser," read at the recent meeting of the American Electrochemical Society, was credited in our report to Dr. Louis A. Parsons. This paper was presented by Mr. C. I. Zimmerman, of Wilkinsburg, Pa., and a fuller abstract of his interesting study will be published shortly.—ED.

The American Street Railway Association.

The twenty-third annual convention of the American Street Railway Association will be held in Recital Hall, Festival Hall Building, World's Fair grounds, St. Louis, Mo., Wednesday and Thursday, October 12 and 13, 1904. One session will be held each day, from 10 A. M. to 1 P. M. The Mechanical and Accountants' associations will meet the same week at the same place, so that all members will have an opportunity of attending all of the conventions and visiting the exposition at the same time. No exhibits will be displayed by the association this year. The headquarters will be at the Southern Hotel.

Mr. James G. White, chairman of the electric railway test committee, announces that the exposition has found it possible to provide adequate space in the Electric Building for the installation of all modern systems for the operation and control of electric cars and trains. The exhibitors of such sets will be requested to so arrange their installations as to make these sets, through dynamometer equipments, available for test in position in the building. On the grounds the exposition company has provided special tracks having an almost level grade and well ballasted for the operation and test of such complete electric railway car and locomotive equipments as shall be offered. These special tracks consist of two parallel sections of track 1,400 feet in length. In addition, terminal facilities will be arranged in a prominent location, capable of holding from twenty to twenty-five fully equipped cars.

The site of the special tracks is parallel with the Transportation and Varied Industries Buildings. Another section of track on the exposition grounds, consisting of two parallel tracks 2,000 feet in length, will presumably also be available for these tests. Further arrangements are being made whereby it is expected that the commission will have the use of additional experimental track about three miles in length, outside of the exposition grounds, for the operation of the heavier equipment. It is believed that these tracks will afford ample space for a comprehensive test upon all present types of electrically equipped cars and locomotives included in the following classes:



ONE END OF THE 10,000-VOLT LIGHTING PIT, SHOWING INSULATING BARRIERS, DOCK STREET SUBSTATION, SCHENECTADY RAILWAY COMPANY.

Equipments Operated from a Central Station—(*a*) Cars equipped for city service. (*b*) Cars equipped for interurban service. (*c*) Industrial electric locomotives. (*d*) Mining locomotives. (*e*) Locomotives for steam railway service conditions.

Equipments Operated by Stored Power —(*a*) Cars equipped for city service. (*b*) Industrial locomotives. (*c*) Mining locomotives. (*d*) Locomotives for steam railway service conditions. (*e*) Heavy tram service, electric automobiles. (*f*) Heavy electric trucks.

The character to be given the tests made the various electrical equipments submitted may, it is thought, be divided as follows:

Tests on Apparatus in Electricity Building—(*a*) Tests on electric railway motor equipments under constant load to determine rate of heating during continuous operation. (*b*) Tests on electric railway motor equipments to determine efficiency of such motors under different fixed conditions of operation. (*c*) Tests on electric railway motor equipments for the purpose of determining their torque curves and accelerating power. (*d*) Tests of hand, automatic and multiple control systems to determine their relative economy, certainty and regularity of starting motor car equipments under fixed loads.

Tests of Electric Railway Equipments on Experimental Track—(*a*) Acceleration tests on single cars and multiple equipped trains. (*b*) Braking tests on single cars and multiple equipped trains. (*c*) Coasting tests on single cars and multiple equipped trains. (*d*) Motor heating tests on single cars and multiple equipped trains. (*e*) Acceleration tests on locomotives and locomotive trains. (*f*) Braking tests on locomotives and locomotive trains. (*g*) Coasting tests on locomotives and locomotive trains. (*h*) Motor heating tests on locomotives and locomotive trains. (*i*) Tests to determine car and train friction.

In the matter of instruments and appliances for the standardization of instruments used in connection with the tests, it is announced that the National Bureau of Standards will erect, in the Palace of Electricity, a laboratory completely and fully equipped with every modern appliance needed for the most accurate and scientific standardization of all types and classes of electrical instruments, meters, etc.

Department of International Research in Terrestrial Magnetism of the Carnegie Institution.

At the annual meeting of the trustees of the Carnegie Institution last December, the establishment of the department of international research in terrestrial magnetism was authorized, and an allotment of $20,000 made, with the expectation that, if the proposed work should be successfully organized, a similar sum would be granted annually.

Dr. L. A. Bauer has been made director of this department, and has been given full authority to organize it, beginning with April 1, 1904. However, he will be able to conduct, at the same time, the magnetic survey of the United States, now under his charge.

It is intended that this department shall investigate problems which relate to the magnetic and electric condition of the earth and its atmosphere, which are not specifically the subject of enquiry of any

one government, but of international concern and benefit. The purpose of this department is to supplement any existing organizations; not to supplant them. The first chief work of the department will consist in the complete reduction, discussion and corollation of the existing observational data, and in the publication of the results in suitable form, in order to exhibit the present state of our knowledge. This will reveal the gaps and suggest future and supplementary investigations. Those having certain phases of work already in hand will be invited to associate themselves with the department.

Telephones in Nova Scotia.

United States Consul-General Holloway, at Halifax, Nova Scotia, reports that much progress is being made in that province as regards improvements in telephone service.

A new line of long-distance telephone, with 292 miles of copper wire, has been opened between Halifax and Sydney, the offices being equipped with the standard relay energy system, including the latest improvements.

The reports of the company show that in the province of Nova Scotia there is one telephone in use for every eighty-eight inhabitants. In the city of Halifax there is one to every twenty-seven persons, while in other towns the proportion is between twenty and thirty.

The report of the general manager of the Nova Scotia Telephone Company shows 790 miles of poles for its long-distance lines and 2,246 miles of copper wire. The total mileage of telephone wires in the province is 7,136, and the total miles of posts are 791.

The number of telephones in the province is 3,260, of which 1,801 are in the city of Halifax. Last year the company transmitted 14,000,000 messages. The long-distance lines unite Truro, Amherst, Bridgewater, New Glasgow and Windsor-Sydney.

The average number of calls per day, per telephone, in Halifax is eleven, compared with seven and one-half under the old system. Halifax answers daily 18,000 calls; the average per telephone is only ten, although some instruments go as high as 150 calls a day.

The rates for conversations of three minutes between Halifax and points in Cape Breton country are each $1.25 in the daytime and sixty-five cents at night between 6 P. M. and 8 A. M.

MEETING OF ELECTRICAL JOBBERS.

A THREE DAYS' SESSION AT BUFFALO, WITH A VIEW TO FORMING A NATIONAL ASSOCIATION — MANUFACTURERS AND CONTRACTORS IN ATTENDANCE.

One of the largest electrical gatherings and one of the most important ever held, commercially considered, convened at Buffalo, N. Y., and was in session Thursday, Friday and Saturday, April 14, 15, 16, of last week. The main body of the convention was composed of the electrical supply dealers and jobbers of the leading cities of the country, and included representatives from Boston, New York, Philadelphia, Pittsburg, Cincinnati, St. Louis, Chicago, St. Paul and Cleveland, in fact all the leading cities; and, in addition, the leading manufacturers and contractors of the United States were present in full force. It was stated that not a single branch of electrical manufacturing was unrepresented.

A number of meetings were held and finally resulted in the appointment of several committees who were delegated to complete plans for the formation of a National Electrical Jobbers' Association, these plans to be reported at a later meeting to be called as soon as the work of the committees is completed.

It developed that the chief object of the gathering of the jobbers, and this was evidently endorsed by the manufacturers and contractors, was for the standardizing of the various products and of methods of carrying on the electrical business. It was believed that the time is ripe for such an organization, one comprehensive in its scope, and including the electrical jobbing interests of the entire United States. The convention adjourned Saturday, and proved to be the occasion of much encouragement and no doubt substantial advantage to the electrical industry.

The ELECTRICAL REVIEW, which apparently was the only electrical journal that realized through its exclusive representation the importance of the gathering, would give a list of the attendance were it not that to publish it would be to present a very comprehensive directory of the electrical men of the United States engaged in manufacturing, distributing and contracting.

A few of those in attendance were W. W. Low and E. M. Scribner, Chicago, Ill.; Frank S. Terry, B. G. Tremaine, and N. C. Cotabish, Cleveland, Ohio; A. C. Garrison, St. Louis, Mo.; William Albert Hall, Cincinnati, Ohio; C. K. Hill, Pittsburg, Pa.; E. M. Downs, St. Paul, Minn.; J. C. Fish, Shelby, Ohio; C. B. Price, Boston, Mass.; H. O. Phillips, Pawtucket, R. I.; W. H. Garland, Pittsburg, Pa.; W. H. Page, Harrison, N. J.; H. H. Geary, Fostoria, Ohio; H. B. Kirkland, Chelsea, Mass.; E. W. Rockefeller, J. B. Olsen, Alex. Henderson, New York.

A visit was made to Niagara Falls and the electrical interests there on Saturday by a number of those in attendance and was greatly enjoyed.

Ionization of the Air.

An investigation intended to throw some light on the question of the spontaneous ionization of the air has been made by Mr. Norman N. Campbell. The experiments consist in the determination of the saturation current through rectangular vessels lined with the metal under investigation, the volumes of the vessels being capable of alteration by the motion parallel to itself of one of the sides of the vessel. It was found that there are two separate, distinct kinds of radiation causing the ionization of the gas: first, a radiation coming from the sides of the vessel, which is completely absorbed by some five centimetres of air, and which gives an ionization in proportion to the surface of the vessel; second, a much more penetrating radiation, which at all volumes gives an ionization in proportion to the volume of the vessel. When the vessel was surrounded with lead sheets, the ionization was diminished. Four metals have been experimented with—lead, aluminum, zinc and tin-foil. In the absence of the screen, the first three gave approximately the same value for the penetrating radiation, causing the volume of ionization. The surface radiation was greater for the aluminum than for the zinc, and still greater for the lead. When the screen was applied, the penetrating radiation was diminished to about two-fifths of its value for all three metals. The surface ionization for the lead and aluminum remained unaltered by the screen, but in the zinc this was decreased, falling to about three-fifths of its original magnitude. Tin was peculiar in its behavior. The volume ionization was about one-third of that in the other metals, and when the screen was applied both the surface and volume ionizations fell, in the same proportion, to two-thirds of their former values. It seems evident that, at least in the case of tin and zinc, secondary radiations are given off from the surfaces of those metals under the influence of penetrating radiations coming from the outside. It is thought that many of the discrepancies that have appeared between the results obtained by different physicists may be explicable by a difference in metal of which their vessels were composed.—*Nature (London), March* 31.

Radium-Bearing Mineral in Quebec.

A radium-bearing mineral has been discovered in an abandoned white mica mine back of Murray Bay, Quebec, by Mr. J. Obalski, inspector of mines. At the recent meeting of the Canadian Mining Institute, Mr. Obalski exhibited specimens of the mineral, and gave an account of its discovery. Uranium ores are the only ones in which radium has been found. In the Canadian Laurentian formation, uranite composed of oxide of uranium and other rare metals has been met with in the pegmatite dykes, which have been operated as producers of white mica. In certain of the mines, monazite, uranite and samarskite have been noticed. About ten years ago Mr. Obalski discovered a remarkable specimen of clovite in a white mica mine. This specimen, which weighs about seven ounces, has been found to contain about 70.71 per cent of uranium. It is well crystallized, and has been found strongly active upon photographic plates. It also has a marked action on the electroscope. This specimen was submitted to Professor E. Rutherford, of McGill University, who found that it contained one-tenth of a milligramme of radium, making it comparable with the best grade of pitchblende so far operated for radium. Mr. Obalski also found a carbonaceous material, burning quite easily and leaving a large proportion of ash, which contained two and one-half per cent of uranium, based on the original weight of the coal. The color of the ash was an olive green, due to the presence of uranium oxide.

An Improved Electric Furnace.

A British patent has recently been granted to Mr. F. J. Tone, engineer of the Carborundum Company, of Niagara Falls, N. Y., for an improved electric furnace. Many experimenters have found that when an oxide of a metal whose temperatures of reduction and volatilization are nearly the same is mixed with carbon sufficient to combine with the oxygen, and is heated to the temperature of reduction, a carbide is the main resulting product; not the metal which was wanted. This is thought to be caused by volatilization of the metal as soon as it is formed, it then combining with the free carbon present in the mixture. To overcome these disadvantages, Mr. Tone has designed a furnace which will give a proper distribution of heat. A resistance furnace is necessary, the heating being accomplished by a core of carbon blocks piled up in the middle furnace, with intervening spaces. The charge consists of a finely divided, thorough mixture of carbon and the oxide to be reduced. This is fed in at the top, and as the oxide is reduced the metal sinks down into the cooler portions of the furnace, finally running into a receptacle at the bottom. This arrangement gives a discharge of heat over a wide zone, so that the progress of the reaction is relatively slow, and the best conditions are obtained for agglomerating the particles. An even temperature is maintained throughout the zone of reaction, so as to prevent volatilization of the metal.

The National Electric Light Association.

The New England Passenger Association and the Trunk Line Association have granted a rate of a fare and a third from points in their territory to Boston for delegates and friends attending the convention of the National Electric Light Association, to be held in Boston, Mass., May 24-27.

The programme for the twenty-seventh convention is rapidly taking definite shape. Papers and reports are already in press, as follows:

"Wrinkles," edited by Charles H. Williams, of Madison, Wis.; "Report on District Heating," E. F. McCabe, chairman; "Report on Purchased Electric Power in Factories," W. H. Atkins, chairman; "Report on Advertising," La Rue Vredenburgh, reporter; "Report on Decorative and Sign Lighting," Arthur Williams, reporter; paper entitled "The Sale of Electrical Energy," by W. F. White; "Practical Notes on Steam Turbines," by Francis Hodgkinson; "A One-Hundred-Mile Transmission Line," by Robert Howes; "Economy Test of 5,500-Horse-Power Engine and Generator," by Messrs. J. D. Andrew and W. F. Wells; "The Remote Control of Electrical Apparatus," by W. H. Cole.

It has been decided to hold the meeting for four days, the last day to be reserved largely for entertaining and sight-seeing in Boston and vicinity. The full particulars of the programme will be completed very soon.

A Sign of the Times.

Charles S. Mellen, the president of the New York, New Haven & Hartford Railroad, in a statement on the methods and policy of that institution, made the following remarks relative to the forthcoming substitution of electricity for steam as a direct motive power in railroad transportation, which is an opinion of great value on account of the independent standpoint of President Mellen, who views the subject solely from that of the railroad expert and not from that of an electrician or from one whose interests have been identified with street car transportation:

"Must steam give way to electricity as a motive power and the steam engine or locomotive be consigned to the scrap heap?"

"I believe we are rapidly approaching the time when this will be done. I think we are making very rapid strides in that direction at the present time. The great obstacles to-day to the substitution of electricity for steam as a motive power upon railroads are the character of the construction of the roads themselves, the frequency of crossings and the danger attending the conducting of the power by third rail.

"These will be greatly overcome, and in the near future, and looking ahead a very few years on such portions of system as have eliminated these dangerous crossings, as, for instance, our line between New York and New Haven, I confidently expect to see the steam locomotive become in the nature of a curiosity."

An Imposition on the General Electric Company.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

A person calling himself George E. McCants, and describing himself on his card as chief electrician of the General Electric Company, Schenectady, N. Y., is traveling in Texas and making representations that he is connected with this company.

I should esteem it a favor if you would insert in your personal columns a note to the effect that there is no person of this name on the payroll of the General Electric Company. It is almost unnecessary to add that there never was any person of this name chief electrician of the company.

E. H. MULLIN.

New York, April 18.

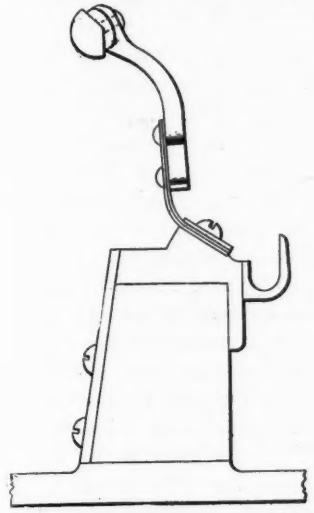
The Directors' Nominees of the American Institute of Electrical Engineers.

The following names have been announced as the directors' nominees of the American Institute of Electrical Engineers for 1904-1905: for president, John W. Lieb, Jr.; for vice-presidents, W. E. Goldsborough, John J. Carty, Samuel Reber; for managers, Henry G. Stott, D. A. Ferguson, James G. White, Schuyler S. Wheeler; for treasurer, George A. Hamilton; for secretary, Ralph W. Pope.

The annual business meeting of the Institute will be held in New York city, Tuesday, May 17, at which time the reports of the board of directors and the treasurer will be presented.

Electrical Patents.

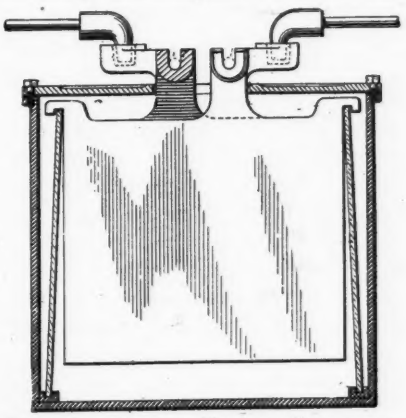
Mr. Frank E. Case, of Schenectady, N. Y., is the inventor of a removable contact finger tip, the object of which is to provide removable tips for contact fingers for electric controllers, which may be secured immovably to the fingers and will have a large area of contact, but



Elevation View Showing a Finger as Usually Mounted in a Controller Supplied with Removable Tip.

which may be easily and cheaply replaced. A support is employed upon which is mounted a brass casting. Mounted upon the casting by means of a spring is a contact finger, having in one side a wedge-shaped recess in which is secured a removable tip by means of its rivet portion, this rivet portion being formed integral with the tip. The tip has a curved contact surface and upon the opposite side is a wedge-shaped projection, formed by walls or surfaces, which is adapted to enter and fit closely into the recess. This construction gives a large area of contact between the finger and tip, and when riveted in place relative movements of the finger and tip are positively prevented. It is necessary that such movement should be prevented, as otherwise the contacts at the surface and between the tip and finger may be impaired. The contact tip is pressed by the action of the spring against a movable contact surface and when not in contact with that surface it is maintained in position by the rigidity of the spring. When the contact tip is in engagement with the moving surface the strain on the tip is taken up by one side wall of the recess and is almost entirely removed from the rivet, since the wedge-shaped recess is formed across the finger in a direction at right angles to the direction of movement of the contact surface.

An improvement in storage battery construction has been patented by Simon Lake, of Bridgeport, Ct., the object of the invention being to form a connection between the plates of a storage battery of such character that individual plates may be removed without disturbing the others or the common connection of those adjacent the one removed. The cell comprises a jar or casing having disposed along the opposite edges of the bottom grooved holding strips, the grooves of which receive the lower edges of glass-supporting plates, upon whose upper edges are hung independent series of positive plates and negative plates, each having hooked lugs, disposed at the upper ends of the opposite edges, the bodies of the plates being separated by the usual non-conducting rods or plates. Each of the alternately arranged positive and negative plates is provided with a central lug for its electrical connection with the adjacent plates or those of the same polarity, the connection lugs of the positive plates being disposed upon one side of the centre line of the cell and the connection lugs of the negative plates being disposed upon the opposite side. Each of the connection lugs is provided with transverse hubs or projections, serving as bearings for the adjacent faces of distance-pieces, interposed between the ad-



Section of Storage Battery Embodying A New Invention.

jacent projections of the connection lugs of the plates of like polarity, and with them forming a sectional bus-bar providing an electrical connection between the plates of each series. The component sections of the bus-bar thus formed are all grooved in the upper side longitudinally to receive a tie-rod or belt, which when provided with a lead coating may suffice to permanently maintain the several sections of the bus-bar in proper electrical contact, but which may be used only in assembling the parts when the opposed faces of the bus-bar sections, suitably prepared, are united in a suitable fused joint by soldering or other well-known means to form an electrically perfect connection between the adjacent members, after which the tie-rod may be withdrawn. The peripheries of the hubs and distance-pieces are preferably chamfered to form a groove or notch between such members for more easily separating them when required. One of each of the connection lugs or its hub is provided with a laterally extending connection-piece, having a socket, entered by the smaller end of an elbow union-piece whose opposite end is similarly socketed to receive the end of a flexible cable, forming the line conductor or the connection between the elements of each battery cell and those of the adjacent cell. The cell is provided with a cover-plate, secured to the marginal flange of the jar upon interposed packing by means of bolts, an aperture being formed in the plate through which the connection lug may project. In case of the buckling of a single plate or its excessive deterioration from any cause, such plate may be readily removed by merely serving the bus-bar by a suitable shearing-tool upon opposite sides of such plate at the joints of the connection-lug bosses with the adjacent distance-pieces and similarly removing the corresponding distance-piece of the other sectional bus-bar of opposite polarity, which distance-piece is disposed directly above the plate to be removed, when the latter may be withdrawn without in any wise disturbing the remaining plates of the cell. When the necessary repair has been effected, the plate is returned to its initial position, with its integral section of the bus-bar intermediate the adjacent sections, which the application of pressure and heat will serve to reunite the parts in a fused point. The removed distance-piece forming a section of the other bus-bar may be similarly reinserted. The application of the necessary heat is readily effected by means of a suitably designed electrical heating appliance for embracing the portion of the bus-bar to be operated upon or by any other heating appliance capable of heating the parts to be united, the sections being drawn together by the use of the tie-rod.

The council of the Central and Associated Chambers of Commerce, of London, England, have adopted the following resolution: "That this Chamber would welcome a measure to facilitate a more practical system of weights and measures than now in use in this country by the introduction of a decimal system, but not by adopting the metric system, which has no affinity to any existing denomination used in trade or commerce in the United Kingdom."

Reviews of Current Engineering and Scientific Literature.

The Maximum Capacity of a Lead Accumulator.

An attempt is here made by M. F. Loppé to compute the maximum possible efficiency of a lead accumulator. If all the active material took part in the reactions during discharge, the least loss of material would change the capacity of the battery. Therefore it is necessary to allow for this, and it is assumed, following Ayrton, that the practical capacity is two-thirds of the total. During the reaction taking place, 1.017 milligrammes of lead are affected for each coulomb, or 3.86 grammes per ampere-hour for each electrode. Therefore, for a practical capacity of one ampere-hour, 5.79 grammes of lead are required for each electrode. The active material of the positive plate will then weigh 6.69 grammes. To arrive at a weight for the grid, well-known types were examined, and it was found that in no case did the grid weigh less than twenty per cent of the complete electrode. However, this figure is taken to give the most favorable conditions. This gives a weight for the negative electrode of 7.24 grammes per ampere-hour, the support weighing 1.45 grammes. Assuming the same weight for the positive grid, the total weight of the electrode is 8.14 grammes per ampere-hour, and the two plates together weigh 15.38 grammes per ampere-hour, corresponding to a maximum capacity of sixty-five ampere-hours per kilogramme. The weight of the electrolyte having a density of 1.285, is 15.55 grammes. The combined weight of the vessel, the connecting strips, etc., was found to be, from a study of well-known types, fifteen per cent of the total weight of the cell, amounting to 4.64 grammes per ampere-hour. The total weight of the cell is then found to be 35.57 grammes per ampere-hour, and the maximum capacity of a lead accumulator is given as 28.1 ampere-hours per kilogramme. This cell could not have an average voltage above 1.9, so that the energy capacity would be 53.39 watt-hours per kilogramme.—*Translated and abstracted from L'Industrie Electrique (Paris), March 25.*

New Receiver for Wireless Telegraphy.

At a recent meeting of the French Academy of Sciences M. Lippmann described a new wireless telegraph receiver devised by M. N. Vasilesco Karpen. This is formed of two plates consisting of sections of a vertical cylinder, and between which is suspended, by a silk fibre, a light aluminum needle carrying on each end a small cylindrical segment. The two armatures are connected together by a coil of wire, and the apparatus, as thus arranged, is placed in the antenna circuit. Upon the passage of current through the coil, due to electrical waves striking the antenna, a difference of potential is set up between the two plates, and the suspended needle turns so as to increase the capacity of the system. When current ceases, the needle returns to its first position. The apparatus is most sensitive when the condition of resonance exists between the coil and the plates. The apparatus may be used for measuring the energy transmitted. In the practical form, the needle is twenty-eight millimetres in length and twenty-five millimetres high. The distance between the needle and the plates is four millimetres. Under these conditions, a difference of potential of one volt between the terminals of the apparatus gives a deviation of fifteen millimetres on a scale placed two millimetres distant. During a test, the following result was obtained: distance of transmission, ten metres; length of antenna, two metres; length of spark, 0.25 millimetre; length of wave, about twelve metres; number of sparks per second, eighty. This gave a permanent deflection of eighty millimetres. The time required to cause a deflection of ten millimetres was two seconds, but this may be reduced by diminishing the moment of inertia of the movable part. In constructing the device, good insulating material must be used, and a quartz fibre is preferable to silk, in order that the zero point may remain fixed.—*Translated and abstracted from L'Eclairage Electrique (Paris), April 2.*

Electromagnetic Clutches and Speed Gears.

Various types of electromagnetic clutches are here described by Mr. Rankin Kennedy. Electromagnetic clutches are used as any other clutch, to control the driving of machines from a continuously running shaft, in one of three ways: to stop and start simply; to stop and reverse; to vary the speed and reverse. The last is the most important purpose to which the electromagnetic gear applies, inasmuch as two engines of growing popularity and importance, namely, the internal combustion engine and the steam turbine, are not readily reversible or easily or economically varied in speed. Of the several types, one of the simplest is that invented by Willans. The clutch has an outer ring, with inwardly projecting poles, similar to the field frame of a direct-current machine. Within this is an armature having an equal number of poles, around which are placed the exciting coils. When there is no current passing through these coils, there is no torque exerted between the two parts; but, upon passing current, torque is developed. This clutch is not capable of developing much torque. It slips readily, and requires close fitting. In the next development, the inner part of the clutch resembles the rotor of an inductor alternator, there being two sets of poles with a large exciting coil placed between. Surrounding this part is a copper cylinder enclosed in an iron ring, which completes the magnetic circuit. When passing current through the coil, eddy currents are set up in the copper cylinder, due to the relative motion of the two parts. A torque is thus developed, which can be controlled by varying the exciting current. This clutch gives an enormous torque, and its action is smooth and regular. However, it tends to slip when suddenly overloaded, due to the inductance of the secondary part; and if it once slips, the driver runs away. An improvement upon this clutch consists in making the outer ring of iron with slots, in which are placed short-circuited coils. In this type the torque is large and the slipping small. In the types of clutch so far considered, the torque is due to electromagnetic reactions. In the next type, the magnetic mechanism serves simply to bring into close contact two rubbing surfaces, the clutch really being a friction clutch operated electrically. This type usually takes the form of a part fixed to the shaft and a loose part, in one of which is embedded a large coil concentric with the shaft. Upon passing current through this the two parts are drawn firmly together. In this type there is no slipping and no opportunity to vary the speed. In the preceding types the speed may be varied, but not reversed. To secure this condition the clutch must be separated into two parts, one of which becomes a motor and the other a dynamo, so that the combination more nearly resembles a gear than a clutch, and acts merely as a connecting link between the constant-speed engine

and the driving shaft. This arrangement allows one machine to have a high speed relative to the other. The speed and direction of rotation of the driven part can be varied at will. This combination is thought to be suitable for turbine-driven boats, and a compact arrangement consists in mounting the two armatures within the same field frame.—*Abstracted from the Electrical Magazine (London), March 25.*

The Conductivity Produced in Rarefied Gas by an Incandescent Cathode.

An investigation of the increased electrical conductivity of rarefied gases, produced by an incandescent cathode, has been made by Messrs. Ernest Merritt and Oscar M. Stewart. This phenomenon is the well-known Edison effect. The apparatus used consisted of a long tube with a carbon filament sealed at one end, and an attachment to an air pump. Around the filament was placed a brass cylinder, connected by means of a wire which passed through the tube to one side of a galvanometer. The galvanometer circuit is completed through a battery of variable potential force, one side of the carbon filament, and the air-gap between the filament and the cylinder. The filament is brought to incandescence by means of currents passed through it, and the difference of potential between the brass cylinder and one leg of the filament is varied by means of the battery mentioned. Experiments were made at high vacua and at low vacua. It was found that the incandescent filament discharges negative electricity, even at the highest vacuum. It seems probable that the electrons by which the charge was carried come from the incandescent body, rather than from the gases in contact with it. There is a striking resemblance between the behavior of an incandescent cathode and an illuminated cathode. At high vacua the cathode ray particles are the sole carriers of the current, and since their number depends chiefly upon the degree of incandescence, the curves show saturation at low values of the electromotive force. As the difference of potential between the filaments and the surrounding cylinder is increased, the cathode rays move at an increasing speed, and finally move fast enough so that, upon colliding with the molecules of gas, these become ionized, the ions thus formed participating in the conduction between the filament and the cylinder, so that the current increases with an increase in the electromotive force. It was found that when the difference of potential was greater than ten volts, the first deflection of the galvanometer was approximately that given by ten volts, but this gradually increased, showing a creeping current. If this effect were due to a slow change in the ionization of the gases, the conductivity might be expected to last a short time after the circuits of the filaments were broken; but this can not be the case, since the galvanometer falls to zero if the lamp circuit is broken suddenly, reversing the direction of electromotive force in the galvanometer circuit, and also bringing the needle to vibration about its zero. The authors suggest that this effect may be due to a gradual change in the incandescent surface, this change being of such a character as to increase the rate at which the cathode rays are produced. When the filament is no longer negatively charged, and when it is allowed to become cold, the surface gradually returns to its original condition. An appreciable amount of residual gas is essential. The temporary nature of the change shows that it can not be due to oxidation of the carbon surface, or to any similar action. The phenomenon is thought to have some points of similarity with cases of excited radioactivity.—*Abstracted from the Physical Review (Lancaster, Pa.), April.*

Notes on the Electrodeposition of Cadmium and Its Alloys.

The field of application of cadmium is still quite limited, although chemists and metallurgists have turned to useful account some of its properties. Mr. Sherrard Cowper-Coles describes, in this article, the uses to which cadmium is put, and the methods of depositing it electrically. Cadmium, in color and appearance, resembles tin, and certain of its alloys melt at very low temperatures, a property which has been made use of in the manufacture of fuses. Its salts are used as pigments and in photography, and its amalgams have been used in dentistry. It is less active chemically than zinc or brass, and is suitable for coating the terminals and connections of primary and secondary batteries. Silver, alloyed with cadmium, does not tarnish as easily as when mixed with copper. The electrodeposition is readily carried out from the same salts as zinc is deposited from, but a higher current density may be used. Smee appears to have been the first to deposit cadmium electrically, but since his time it has received little attention. He used a bath of ammonium sulphate, but was unable to obtain good deposits from sulphate or chloride solutions. Woolrich and Russell deposited cadmium from a potassium cyanide solution, prepared by dissolving cadmium in nitric acid and then precipitating it with sodium carbonate, the precipitate being dissolved in the cyanide. The deposition of a cadmium-silver alloy in any desired proportion may be carried out without difficulty. To obtain deposits of from ten to eighty per cent of cadmium, it is found necessary to have the ratio of the silver and cadmium in solution in the proportion of from one to four to one to seven, the best results being obtained when the amount of metal in solution is from three to four ounces per gallon, and the amount of silver per gallon not less than eight nor more than twenty-five pennyweights. The weaker the solution the smaller must be the current density. For every composition of the solutions a definite current density must be used to bring down a given deposit. If the solution be stirred, higher densities may be used; but to ensure an alloy of the desired proportions being deposited it is essential to watch carefully the color of the deposit, as well as the current density. Since brass and silver-cadmium alloys are the only alloys that have been successfully deposited, the electrodeposition of alloys opens a large field for investigation by the electrochemist. These alloys may be deposited in all proportions, apparently as true alloys. When attempts were made to roll a cast alloy containing seventy per cent of cadmium and thirty per cent of silver, it was found to split up in an extraordinary way, showing a remarkable structural formation. The cracks formed divided the plate into regular triangularly shaped strips.—*Abstracted from the Electrochemist and Metallurgist (London), March.*

BOOK REVIEW.

"Twentieth Century Handbook for Engineers and Electricians." C. F. Swingle, H. C. Horstman and Victor H. Tousley. Chicago. Frederick J. Drake & Company. Flexible leather. 220 pages. 4¾ by 6¾ inches. Numerous illustrations. Supplied by the ELECTRICAL REVIEW at $2.50.

This handbook is intended entirely for engineers who are now in charge of mechanical plants, and who have not had the benefit of a theoretical training. A number of tables are given, and a pretty general résumé of the theory of engine and boiler management. Part two is devoted to electricity for engineers, and this is supplemented by a number of illustrations showing circuit diagram and various forms of apparatus. There is not a single mathematical formula involving more than ordinary arithmetic in the whole book.

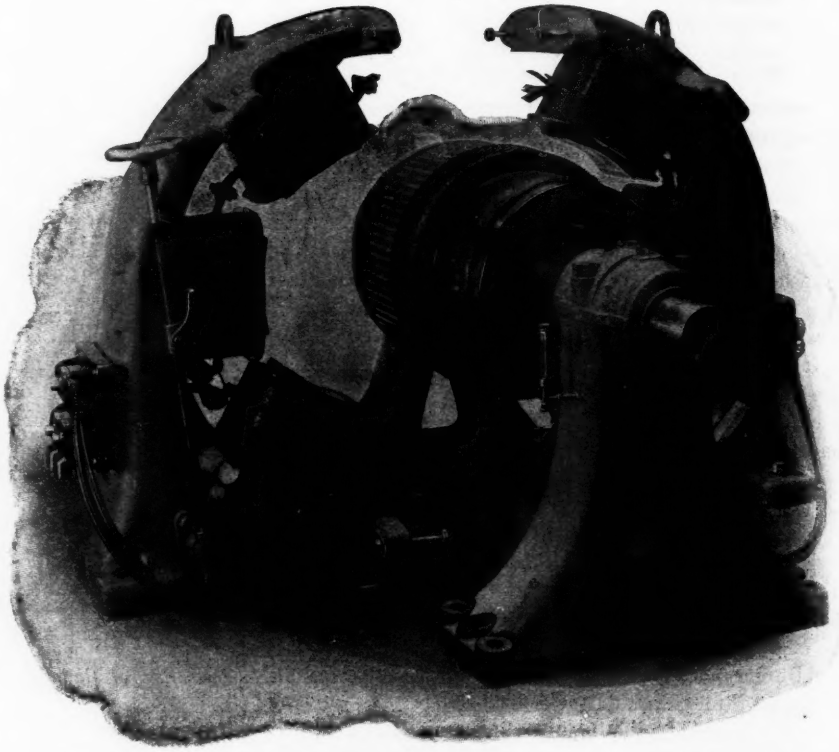
INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Direct-Driven Generators for Power and Lighting.

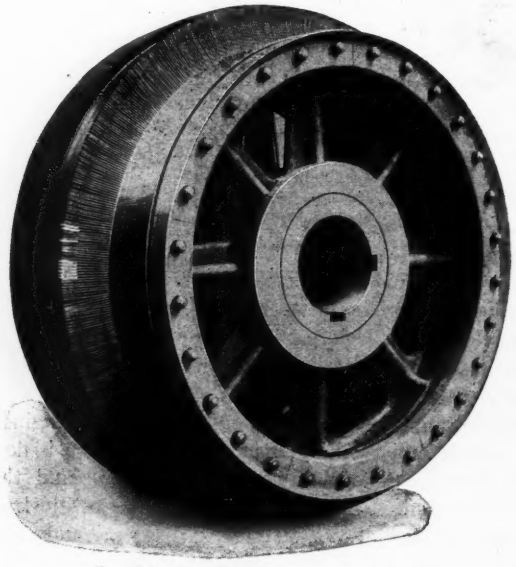
The Western Electric Company, Chicago, Ill., in designing the line of type L generators, details of which are shown in the accompanying illustrations, has embodied such features of its earlier designs as had proven satisfactory, and has introduced many improvements where study and experience have shown this possible. The larger generator frames are of cast iron, while in the smaller ones, where the section necessitated by the requirements of the magnetic flux is greater than would be necessitated by mechanical strength, a special material of high magnetic permeability is used. This construction affords the best results, with a minimum weight of material.

In the standard construction the frame is divided vertically, which permits of drawing the yoke apart horizontally, allowing the armature to be inspected or removed. The method of bolting the frame to the extended engine subbase allows adjustment both horizontally and vertically, ensuring uniform air-gap and balanced magnetic field. When engine-room conditions make it necessary, the company is prepared to furnish the standard machines with horizontally divided frames.



GENERATOR, WITH FRAME PARTIALLY WITHDRAWN FOR ARMATURE INSPECTION.

To eliminate, as much as possible, losses due to eddy currents in the pole tips, laminated pole-piece construction has been adopted. The pole-pieces are built up of thin sheets of thoroughly annealed mild steel, the various sheets being both bolted and riveted together. When the pole-pieces have been assembled, they are placed in a clamping plate, and the metal which forms the frame is poured around the outer and jagged ends of the pole-pieces. By this construction an extensive area of magnetic contact between the pole-pieces and the frame is obtained. In addition to this, a partial weld is possible between the pole-pieces and the yoke. This con-

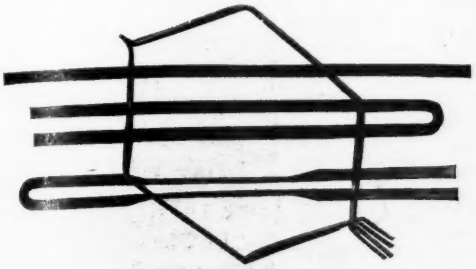


COMPLETED ARMATURE.

ARMATURE DURING WINDING.

struction reduces the magnetic reluctance to the lowest possible point, and also gives, the manufacturer claims, a perfect magnetic distribution.

In the standard construction the shunt and series field coils, although separately



ARMATURE COILS.

wound and insulated, are mounted on a single metallic spool. This method affords additional mechanical protection, and facilitates not only the shipment, but also the handling of the coils during erection.

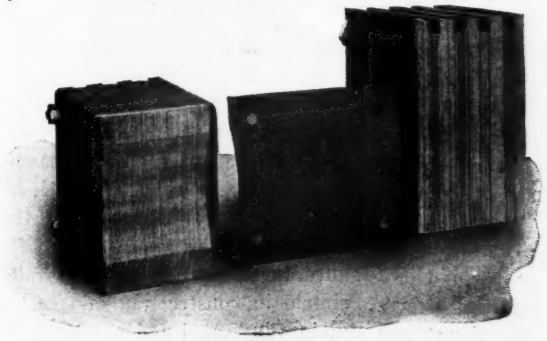
The armature is of the ironclad type. The armature core is made up of thin discs of doubly annealed sheet steel. After the slots have been carefully punched in the periphery of these discs, the final annealing is given. By this method any hardening effect caused by the punching of the slots is removed. Radial ventilating spaces are provided, which connect with horizontal openings in the armature centre, allowing a thorough system of ventilation. The smaller armatures are built up of continuous rings, while in the larger machines, on account of the difficulty of obtaining iron in sheets sufficiently large, the method of building in segments has been adopted.

After being built up in this way, and after having the commutator and armature windings placed in position, the armature is mounted on the engine shaft. The company employs what is termed the "double fit" construction, which provides for two sizes of armature shaft and bore of armature centre. The difference in these dimensions is very slight, but sufficient to permit, in mounting, of the armature centre being well under the engine shaft before it is required to apply pressure.

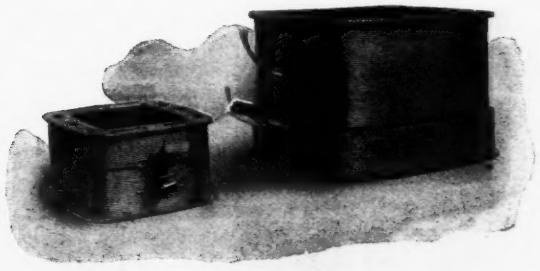
In winding the armature, solid bars of specially drawn copper are used. The coils are enlarged in cross-section at the ends of the armature, obtaining a low armature resistance and a consequent gain in efficiency. The bars are formed into coils before being placed on the armature, so that, when completed, a symmetrical and balanced winding is secured. They are insulated individually and in groups, the insulation, as well as the bar itself, being continuous from segment to segment of the commutator. At the various steps in the insulation process, the bars are immersed in insulating compound and thoroughly baked. The shape of the armature slot and the notches near the top of the slot permit of retaining the coil in place by means of fibre wedges. In addition to these wedges, on the smaller sizes the coils are held in place at the pulley or engine end of the armature by a brass ring extending over and clamping the ends of the coils. In the larger sizes this construction is not used, but a finishing plate is placed at the pulley or engine end of the armature, and band wires are used on that portion of the armature winding lying outside of the armature core.

The commutators are of rigid construction, and the segments are made of the best drawn copper, and have riveted and sweated to them rolled copper tangs. The segments are insulated from each other by specially prepared mica. In all but the smaller sizes, the segments are mounted upon a cast-iron centre, from which they are insulated by mica. The completed commutator is then mounted upon the extended head of the armature centre, thereby permitting it to be removed from the armature without disturbing the armature mounting. A thorough system of ventilation is provided by means of horizontal air ducts. In the smaller sizes, in order that this ventilation may be obtained, it is necessary to cast the commutator centre integrally with the armature centre. The segments are then mounted in the manner described.

Each set of brush-holders is mounted upon a brush-holder arm supported from a circular ring. This ring is carried in supports projecting from the yoke, the entire device being moved around the commutator by means of a hand-wheel at the side of the machine. The brush-holders are designed so that the brushes may be moved in a direction radial to the surface of the commutator. Each brush is held firmly in a clamp in such a manner that the current does not pass through any sliding contacts. Any brush may be lifted from the commutator without disturbing the adjustment of the others, and all brushes may be adjusted independently.



POLE-PIECE CONSTRUCTION.



FIELD COILS.

The Demand for Conduit.

One of the foremost manufacturers of vitrified clay conduit is the Standard Vitrified Conduit Company, 39-41 Cortlandt street, New York city. This company has extensive factories and equipment for turning out this product at South River, N. J., and owing to the great demand for its conduit these factories have been operated continuously since opening in 1902. The company states that it can produce annually 40,000,000 feet of conduit at these factories, and this has enabled such prompt deliveries as to gain it an enviable reputation in the trade.

Under patents of Mr. R. W. Lyle this company is manufacturing multiple-duct conduit. It also furnishes with its single duct, free to its customers, its patented mandrel for laying single duct, which yields great economy in construction. Ample stock of both standard and special sizes, together with fittings, is kept on hand for delivery at short notice.

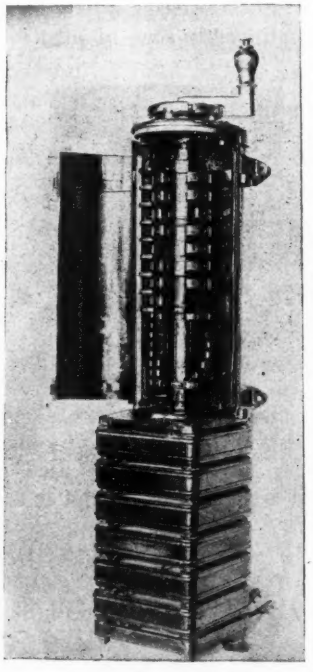
The company has facilities at its South River factories for shipping either by rail or water. Among the largest buyers of the "Standard" vitrified conduit are the

Bell Telephone Company, New York, Boston and southern states, Rapid Transit Subway Construction Company (New York tunnel), Manhattan Elevated, Metropolitan Street Railway Company, Consolidated Telephone and Electric Subway Company, New York Edison Company, Brooklyn Edison Company, Brooklyn Rapid Transit Company, Brooklyn Elevated Railway Company, the Philadelphia Edison Company, the Philadelphia Rapid Transit Company, New York Tunnel Company, Westinghouse, Church, Kerr & Company, United Engineering and Construction Company, Western Electric Company, Standard Underground Cable Company, Safety Insulated Wire and Cable Company, Pennsylvania Railroad Company, Baltimore & Ohio Railroad Company, New York Continental Jewell Filtration Company, Hudson River Water Power Company, Niagara Falls Power Company.

The company has recently published a new art catalogue, describing its process and products. This will be mailed upon request to the company.

Regulating and Reversing Controllers for Machine Tool Service.

The use of individual motors for driving machinery has grown in general favor as the advantages derived from an



INSIDE VIEW OF TYPE-V CONTROLLER.

independent source of power for each appliance have become recognized. Shunt and compound variable-speed direct-current motors especially adapted for such service have been designed, and suitable controllers for applying the power to the work in hand and properly regulating the speed of the machinery are thus a prime requisite.

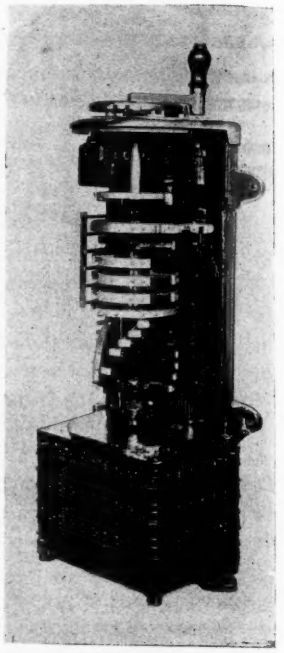
A line of controllers, particularly adapted for use with independently driven machine tools, is manufactured by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., and known as types V and W, the assortment being comprised of over 600 different sizes and capacities, to cover all the requirements of service. The type-V controllers are used upon the two-wire single-voltage circuits, eight forward speeds and four reverse speeds being obtained by resistance in the shunt field circuit. In the type-W, used upon three-wire two-voltage circuits, the speed variations are obtained by means of the two voltages as well as the shunt resistance, provision being made for six forward speeds on the lower and nine on the higher voltage, and six reverse speeds on the lower voltage.

The type-V controllers are ordinarily adopted when a speed variation of two to one is required and the type-W for variations of four to one, although other variations may be obtained as desired, each installation being separately considered and the controller used which is best adapted to the motor with which it is to be used. The successive intermediate speeds are arranged in practically geometrical progression, but extra leads are provided by the use of which the owner may make such changes as he desires.

In general structure, these controllers are based upon the most modern and improved types of Westinghouse design. The drum is made of metal and secured to an insulated shaft. The contact strips are of hard rolled copper. The fingers are also made of hard rolled copper and provided with lock nuts and adjusting screws. All parts are liberally proportioned and are made easy of access. The cover can be removed by withdrawing with the fingers the pins which hold it in place, and access to the leads is quickly obtained by removing the strips screwed to the back of the controller. The contacts, the arcing tips on the main contacts, and the fingers are easily removed and renewed.

Another important particular which assures the adaptability of these controllers to various conditions is the fact that the handle and ratchet are so designed that they may be removed from the controller and placed at any point which is convenient, and which permits connection to the controller by means of bevel gears and shafting. This not only adapts the apparatus for distant control, but it enables the operator to use the identical handle, ratchet and indicator dial which are furnished with the controller. This not only saves the expense of making a new handle and ratchet, but retains the advantages of the peculiarities of the Westinghouse operating mechanism.

The notches in the ratchet are positive,



INSIDE VIEW OF TYPE-W CONTROLLER.

and the design is such that as each step is reached a key drops into a notch and stops the handle, holding it firmly in place until released by a pressure upon the thumb stop in the end of the handle. The operator is thus able to watch his work uninterruptedly while applying the power or changing the speed, a fact of distinct advantage. The handle and ratchet are simple in construction and each step is plainly indicated and numbered.

In the type-V controller the starting resistance is inserted when the first contact is made, being cut out when the handle is moved to the second position.

In the type-W, a cam lifts from the contact the finger whose function is to cut out the starting resistance, and thus leaves the resistance in circuit when starting or when changing to a higher or a lower voltage. By means of a dashpot the return of the finger is delayed for a predetermined interval of time, the speed of the return being regulated by means of a screw. The checking medium is a non-freezing liquid, greatly superior to air as a means of even and close regulation, and not affected by atmospheric conditions. If desired, the dashpot can be removed without disturbing any other portions of the controller.

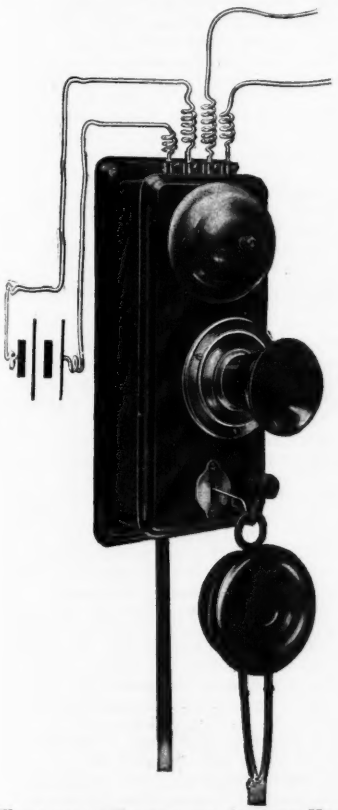
Arc shields are placed between all contacts which carry the main current, and in addition all sizes above ten horse-power have a powerful magnetic blowout coil.

In capacities to and including ten horse-power the resistance, which is of the imbedded type, is regularly mounted directly beneath the controller. In larger sizes it is mounted separately. The leads are conveniently located and have screw connectors.

In every particular these controllers are designed to give superior service under even the least favorable conditions. They have an unusual amount of strength and durability, and the large assortment ensures the adoption of the proper controller to give the best results in every instance.

The "Workwell" Telephone.

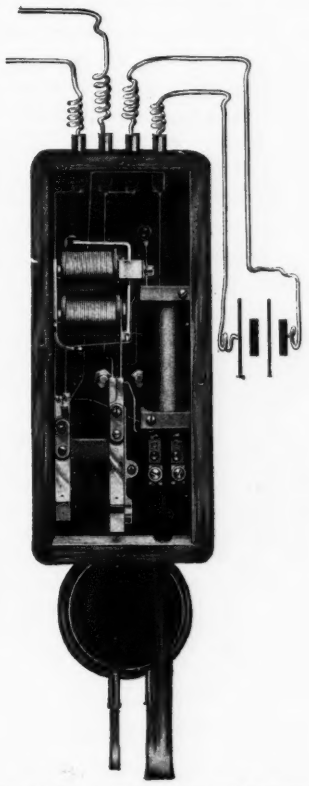
The accompanying illustrations show a new type of intercommunicating telephone placed on the market by the S. H. Couch



"Workwell" Telephone, Outside View.

Company, 160 Pearl street, Boston, Mass. This instrument is made of quartered-oak front, plain oak sides and back, and varnished in a first-class manner. The bell is high grade in every respect, and will ring as well as any direct-current bell through a like resistance with a like amount of battery current. The movement has double adjustment and is easy of access. The gong is two and one-half inches in diameter, and highly nickel-plated.

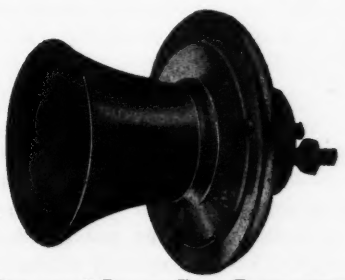
The apparatus is equipped with self-contained hook switch, which is positive in



Inside View, "Workwell" Telephone.

action, and the manufacturer claims can not stick. The contact springs are of German silver, and are pointed. The hook has roller bearings, and forms no part of the circuit. The parts are mounted upon a cast-brass base. The push-button has three points, and is of similar construction to the hook switch. The induction coil has duplex windings with fibre heads. Twenty-four inches of worsted cord are provided. The binding-posts are of one piece and obviate any danger of disconnection.

The receiver is of solid double-pole con-



"Reliance" Button-Type Transmitter.

struction, with three-ring permanent magnets and silk-wound coils with concealed cord terminals.

The company's well-known "Reliance" transmitter is used, this being fitted with a button-type cell and aluminum diaphragm. The bridge is of cast brass, and the shell is of polished brass, nickeled. This transmitter gives a clear-tone powerful transmission, and is guaranteed to produce first-class results.

All wiring connections are soldered, all the instruments being wired alike—that is, for two on a circuit. These instruments may be wired to order for hotel, school, residence or other interior systems, according to conditions.

The S. H. Couch Company is the manufacturer of a complete line of telephones and switchboards.

Steam Turbine Power Plant for Boston Navy Yard.

An interesting departure in the engineering practice by the authorities of the United States Navy, department of yards and docks, is marked by the introduction of Westinghouse-Parsons steam turbines for furnishing power for lighting the buildings and yards, and power for operating dry-dock pumps and miscellaneous machinery.

The initial installation of this character is in process of construction at the Charlestown navy yard, Boston, Mass., and for the present one Westinghouse-Parsons turbine generating unit of 750-kilowatt capacity will be placed in service. This turbine will be of the new short-barreled type and is now under construction at Pittsburg. A Worthington surface condenser will be employed, using salt-water for circulation. The condensers will be located between the foundations, which consist of concrete piers. A running vacuum of twenty-eight inches will be secured through the aid of a dry air pump. Steam will be furnished at 150 pounds pressure by Babcock & Wilcox boilers in units of 350 horse-power, equipped with Roney mechanical stokers. Coil superheaters in the boiler settings will furnish to the turbine a superheat of about 100 degrees Fahrenheit. The boiler house will be equipped with a complete outfit of coal and ash-handling machinery.

The present power plant is the outcome of an appropriation made in 1898 by Congress for a dry-dock and pumping plant to be located at the Charlestown navy yard; the new plans for a dry-dock equipment providing for a power plant located near the outer end of the new dock with piping connections to both old and new docks, so that the one pumping plant would be able to handle them simultaneously or separately. During the period

of construction of the new dock the department of yards and docks at this navy yard underwent considerable enlargement, necessitating an immediate increase in an electrical generating equipment for supplying light and power to buildings and departments.

In view of this situation, it was decided to supersede the dock pumping plant, originally provided for, by a central lighting, power and heating plant for the entire department, although retaining the dry-dock pumping equipment which will now be electrically driven from the central station. It is also intended to supply from this plant electric light and power to the vessels docking which do not happen to be under steam. The power system as now under construction is, therefore, considerably more comprehensive than originally laid out.

The turbine plant will supply three-phase alternating current at 2,300 volts, this voltage being used for general distribution and for direct use in larger motors, while for lighting, lower voltage will be provided by transformation. The turbine generator will be served by a thirty-seven and one-half kilowatt Westinghouse compound exciter unit.

The engineering work is under joint execution by the department of yards and docks and the constructing engineers, Westinghouse, Church, Kerr & Company, who are installing the plant.

Electricity in Car Shops.

A description of the London & Northwestern car shops at Wolverton, England, which is given in *Engineering* (London) for April 1, shows how important electrical driving is becoming in all kinds of shops. These are the shops of the London & Northwestern Railway. They cover eighty acres, and employ about 4,500 men in the car department alone. The locomotive department, formerly located here, has been removed to Crewe.

In the engine room there are five main engines, two triple-expansion condensing, each direct-connected to a 200-kilowatt six-pole compound-wound generator running at 420 revolutions per minute. There are two triple-expansion condensing engines, each coupled to a 400-kilowatt eight-pole compound-wound generator running at 360 revolutions, and a Bumstead & Chandler engine connected to a 430-kilowatt compound-wound generator. All the dynamos have a voltage of 250. From this power-house the following shops are driven: the sawmill, the fitting and turning shop, the carpenter shop, the smith shop, the truck and under-flame shop, the baggage-car shop, the wheel and axle shop, the crane and lifting shops and the finishing shops. The machinery in these shops is motor-driven. In the greater number of cases the motors drive sections of shafting, in order to save having a large stock of spare armatures. The motors are usually of ten to twenty horsepower. In the case of the larger machines, most of which are in the sawmill, there is a motor on each machine. The motors are placed on a platform overhead, about the level of the countershafting, and are reached by steps for cleaning and lubrication. The yard is lighted during working hours by arc lamps fixed upon posts, which posts also carry two incandescent lamps each, the latter for use at night after working hours. The general lighting is by means of arc lamps. In a few shops inverted arcs are used, but, as a rule, the ordinary pattern is found to give a better light. In the painting and repair shops incandescent lamps only are used, suspended at fifteen-foot centres. Incandescent lamps are also used over the vises and benches, and one to each machine. The transfer tables are operated electrically from an overhead trolley. The overhead cranes are of the three-motor type. Much of the welding is done by means of Thomson welders. The shops are also fully equipped with hydraulic and pneumatic tools and hoists.

Electric Railroads in Peru.

United States Consul A. L. M. Gottschalk, at Callao, reports that the electric tramway from Lima to Chorrillos—the first to be operated in Peru—was opened on February 17.

The new road is eight miles long and reaches at present to Barranco, a popular neighboring seaside resort. The purpose of the road is to afford cheap and rapid transit between Lima and the much frequented bathing resorts of Miraflores, Barranco, Buen Pastor, Chorrillos, etc. The road is destined to do much toward the future extension of Lima, which is rapidly losing its almost mediæval character and is reaching out quite perceptibly in various directions—the new movement being characterized by the erection of handsome buildings of modern architecture and the laying out of broad streets and boulevards.

The cars and electric plant are of American manufacture.

A few months more will witness the completion of another electric tramway line between Callao and Lima. The road is about ten miles long and will have a double track. The opening of this road will have a marked effect in drawing Lima and its port Callao even more closely than they are at present, and it will probably cause a sensible diminution in the rather high passenger rates now charged by the two (steam) railroads in operation between Callao and the capital.

American Institute of Electrical Engineers.

ASSOCIATES ELECTED AT DIRECTORS' MEETING, NEW YORK, FRIDAY, MARCH 25.

Francis Ramsey Allen, Ithaca, N. Y.
Wm. Anderson, Cascade, British Columbia.
William Courtney Appleton, Atlanta, Ga.
Orla Fingen Asbury, Charlotte, N. C.
Allen Harwood Babcock, Oakland, Cal.
Louis W. Bates, Brooklyn, N. Y.
Ackert Bickel, Kansas City, Mo.
Eli Judson Blake, Newark, N. J.
Felix William Boldenweck, Chicago, Ill.
Arthur B. Bond, Pittsburg, Pa.
Morgan Evan Bonyun, Atlanta, Ga.
Renshaw Borie, Wilkinsburg, Pa.
Ralph Hubbard Bouligny, Atlanta, Ga.
William Burke Brady, Jersey City, N. J.
Charles P. Bruch, New York city, N. Y.
William Joseph Canada, Springfield, Ohio.
Willard L. Candee, Brooklyn, N. Y.
Rufus N. Chamberlain, Depew, N. Y.
Joseph Samuel Childs, Buffalo, N. Y.
Henry A. Coles, Atlanta, Ga.
G. A. Cowle, Melbourne, Victoria, Australia.
George Sanford Davis, Montreal, Quebec.
Americo Vieira le Castro, Porto Portugal.
Etienne de Foder, Budapest, Hungary.
Lee De Forest, New York city, N. Y.
Theodore Dimon, New York city, N. Y.
Paul Doty, Denver, Col.
Robert V. Dunbar, Brooklyn, N. Y.
Joseph Epstein, Frankfort, Germany.
Paul Willard England, Philadelphia, Pa.
William Albert Evans, Philadelphia, Pa.
Robert John Feather, Columbus, Ohio.
Walter Everest Foreman, Pittsburg, Pa.
Robert M. Fraser, New York city, N. Y.
George A. Gabriel, Cumberland Mills, Me.
Clarence A. Gaines, Salt Lake City, Utah.
William James Garnett, Newport, R. I.
Charles Henry Gilbert, Worcester, Mass.
Arthur Fuller Giles, Atlanta, Ga.
George Tester Goldman, Schenectady, N. Y.
Robert Hogue Goodwillie, Yonkers, N. Y.
Dean Harvey, Chicago, Ill.
William Pitt Hazen, Columbus, Ohio.
Hans Edward Heidenreich, Riga, Russia.
Clark Travis Henderson, Pittsburg, Pa.
Hidetaro Ho, Tokio, Japan.
William Earle Holcombe, Atlanta, Ga.
Sandford H. Horne, San Francisco, Cal.
Richard Edie Hull, Columbus, Ohio.
James Edmund Ives, New York city, N. Y.
Philip T. Jackson, Montreal, Canada.
P. N. Jones, Cleveland, Ohio.
Arthur Keller, Madison, Wis.
Alex. Cartwright Lanier, Knoxville, Tenn.
Ralph Roberts Laxton, Atlanta, Ga.
Fred. Mitchell Laxton, Atlanta, Ga.
Fritz Albin Lindberg, Chicago, Ill.
Joel Willson Little, Atlanta, Ga.
Joseph Brian Lukes, Seattle, Wash.
Geo. S. Maben, Wellington, New Zealand.
Rush Emmett Manley, Columbus, Ohio.
James S. McCulloh, New York city, N. Y.
Frank C. McGonigle, New Castle, Pa.
William A. McTaggart, Schenectady, N. Y.
Frank Hegan Miller, Louisville, Ky.
Theo. Blackwell Morgan, Brooklyn, N. Y.
Bryce Eugene Morrow, Glens Falls, N. Y.
Bangalore D. Nath, Schenectady, N. Y.
John Howard Ogle, New Orleans, La.
Harry Allen Orr, Atlanta, Ga.
Nathaniel Paige, Jr., St. Louis, Mo.
William P. Poynton, New York city, N. Y.
William Montelius Price, Seattle, Wash.
Samuel Arthur Redding, Atlanta, Ga.
Lyman Coleman Reed, New Orleans, La.
Arthur Harold Serrell, Brooklyn, N. Y.
Carl Wadsworth Sharer, Philadelphia, Pa.
Frederick Grant Simpson, Seattle, Wash.
Arthur Bessey Smith, Woodbine, Iowa.
Frank J. Stone, Somerville, Mass.
Seijiro Sugiyama, Osaka, Japan.
L. H. Thullen, Edgewood, Park, Pa.
Joseph Van Eman Titus, Keokuk, Iowa.
Harlan Page Wellman, Ashland, Ky.
Ben Willard, New Orleans, La.
Edwin E. Witerby, New York city, N. Y.
Guy F. Williams, New York city, N. Y.
Constantin Zorawski, Riga, Russia.

TRANSFERRED FROM ASSOCIATE TO MEMBER.

Jos. Phineas Davis, New York city, N. Y.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

NEW WESTERN INTERURBAN LINE—At a meeting of the directors of the new Kansas City & Olathe Electric Railway, held in Rosedale, Mo., recently, contracts were closed and approved for the building of about 300 miles of trolley lines in southeast Kansas, these to become directly tributary to Kansas City. The Kansas City & Olathe line will be double-track practically all of its distance, and over this line a number of other companies are to enter Kansas City.

PRELIMINARY TRIP MADE THROUGH NEW YORK CITY RAPID TRANSIT SUBWAY—Mr. August Belmont, president of the Interborough Rapid Transit Company; Mr. John B. McDonald, constructing contractor, and a number of officials of the Interborough Rapid Transit Company, made a trip through the subway last week. The train was made up of a passenger coach drawn by a Manhattan Elevated Railroad pony engine, the steam being made from an improvised oil burner.

CONSTRUCTION WORK TO BEGIN ON THE GREAT NORTHERN POWER COMPANY'S PLANT NEAR DULUTH, MINN.—The Great Northern Power Company, Duluth, Minn., has begun the purchase of machinery, and, it is stated, within a few months will commence the actual work of erecting a power plant to make use of the waters of the St. Louis river and the watershed back of Duluth. A plant of 30,000 horse-power will be installed at first, the total capacity to be very much in excess of this. Preparations have been going on for this power plant for some five years, and surveys have now been finished and the property acquired for the project.

NEW ELECTRIC ROAD UP MOUNT VESUVIUS—By the opening of a new electric railway European travelers and visitors will be able to make a quick trip up Mount Vesuvius in modern cars. The starting point of the new line, which has been constructed for Thomas Cook & Son, the tourist agents, is at Pugliano, where connection with Naples by electric cars is made. The length of the railway, exclusive of the old Funicular line, up to the cone is 4.7 miles, and it is divided into three sections. The first and third sections are ordinary lines. The second section is a rack and pinion railway. The cars of this section are operated by a powerful four-wheel electric locomotive, which is fitted with an elaborate system of ordinary and emergency brakes. Power throughout is supplied by overhead trolleys.

RUSSIAN WAR OFFICE OBJECTING TO USE OF WIRELESS TELEGRAPHY BY NEWSPAPER CORRESPONDENTS—The Russian ambassador has notified the secretary of state that his government has directed that newspaper correspondents using wireless telegraphy within the theatre of war shall be regarded as spies. In his note to the secretary Count Cassini is quoted as saying: "I am instructed by my government, in order to avoid every possible misunderstanding, to inform your excellency that the lieutenant of his imperial majesty in the far east has just made the following declaration: 'In case neutral vessels having on board correspondents who may communicate war news to the enemy by means of improved apparatus not yet provided for by existing conventions should be arrested off the coast of Kwantung or within the zone of operations of the Russian fleet, such correspondents shall be regarded as spies and the vessels provided with wireless telegraphic apparatus shall be seized as lawful prize.'" This pronunciamento has since been suspended.

EQUIPMENT FOR NEW ZEALAND ELECTRIC TRACTION SYSTEM TO BE PURCHASED IN THE UNITED STATES—An extensive electric traction system is to be constructed in and around Christchurch, New Zealand. While a New Zealand concern—the New Zealand Electric Construction Company, which was organized recently for the purpose of developing the water powers of New Zealand—will carry out the work of building the Christchurch lines, it is stated that practically all the material, equipment, etc., will be manufactured in the United States. About thirty miles of road will be constructed under the existing contract, the value of which is about $1,250,000. The municipal authorities will operate the lines. The city of Christchurch has a population of about 50,000, and the existing lines are mostly operated by steam. The Canterbury Traction Company runs an eight-mile line to Sumner, another line goes to Sunnyside, and still another runs to Port Hill and Sydneham, all suburbs of Christchurch. In the city proper about ten miles of steam and horse lines are operated. The municipal authorities have acquired all of these systems and they will be electrically converted.

TELEPHONE AND TELEGRAPH.

LA GRANDE, ORE.—A telephone line is to be built to connect La Grande and Alice.

TRINIDAD, COL.—The Colorado Telephone Company has moved into its new building, which represents an expenditure of $100,000.

SUMMITVILLE, IND.—The Delaware & Madison County Telephone Company has purchased the telephone exchange at Summitville.

MERIDEN, CT.—The Southern New England Telephone Company expects to have its new exchange in operation by May 1. The common battery system is to be used.

MASON, MICH.—The business men of Mason have formed a telephone company to connect with all independent farmers' lines in the county. Connections will be made with Okemos and with Aurelius.

PRAIRIE DU CHIEN, WIS.—The Union telephone exchange of this city has been sold to J. W. Callaway, of La Crosse, for $7,000, and is to be worked in connection with a number of exchanges in the cities of this part of the state.

SOMERVILLE, OHIO—At a recent meeting of the village council the Hamilton Home Telephone Company was granted a franchise to construct, maintain and operate a telephone system in the village. The lines are now being built from Collinsville to Somerville.

BLOOMINGTON, IND.—It is announced that the Bloomington Telephone Company has been sold to the independent company operating at Bedford, Seymour and Louisville for $20,000. The plant is to be rebuilt, and a new twenty-year franchise has been secured.

PHILADELPHIA, PA.—It is reported that the Keystone Telephone Company, since the first of the year, has installed new telephones to the number of 1,200. The statement is made that the net earnings for the first quarter of the present year will surpass largely those of the corresponding period last year, when the profits were $41,000.

POUGHKEEPSIE, N. Y.—The Dutchess County Telephone Company has begun work on its line to Millertan. This will connect Pleasant Valley, Salt Point, Clinton Corners, Stanfordville, Bangall and Pine Plains. As soon as this branch is completed the company will start work on its line to Millbrook, going through Manchester Bridge.

DENVER, COL.—The Postal Telegraph Company's new line will be completed to Denver very shortly. This line follows the Union Pacific west from Omaha to Julesburg, over the Julesburg branch to La Salle, from which place one line runs to Denver and the other to Cheyenne. Construction of the line west from this city will be pushed as rapidly as possible, and it is expected the company will handle business between Cheyenne and Salt Lake before the first of October.

SPENCERPORT, N. Y.—The business men of Hamlin have organized a local telephone company. This company has all the territory in that town west of the East Hamlin road, the Hilton company meeting the Hamlin line at that place. The line will extend to Morton. Following are the officers of the Hamlin company: president, D. R. Singleton; vice-president, Christopher Rath; secretary, H. F. Newman; treasurer, Charles Baase. The directors are: John Martin, Isaac Palmer, Christopher Rath, James G. Barry, Blaine Snook, Charles Baase, H. F. Newman, T. O. Swanson and

D. R. Singleton. The company will have connection with the Bell Telephone Company.

ROME, IOWA—The farmers of the Pleasant Point district have formed a telephone company.

TAMA, IOWA—The Tama Telephone Company has been incorporated with a capital stock of $15,000.

POCAHONTAS, IOWA—The Pomeroy-Palmer Telephone Company has been organized to build a rural line.

UNION CENTER, N. Y.—A telephone company has been formed to erect a telephone line from Maine to Union.

ST. CHARLES, MO.—The Kinloch Telephone Company has completed its new line from this city to Portage des Sioux.

BLOOMDALE, OHIO—The Central Union Telephone Company is completing a direct toll line from Fostoria to this place.

WINNIPEG, MANITOBA—The North American Telegraph Company will increase its capital from $1,000,000 to $10,000,000.

SWEDESBORO, N. J.—The People's Rural Telephone Company will build its line from this place to Mullica Hill as soon as possible.

AUBURN, N. Y.—The Empire State Telephone Company is making preparations to rebuild its line from Seneca Falls to Trumansburg.

ELLERY, N. Y.—At its annual meeting the Ellery Telephone Company elected the following officers: president, John Skillman; secretary, Claude Haskins; treasurer, Grant Cowden.

WAUSAUKEE, WIS.—The Wausaukee Telephone Company has sold its toll lines, reaching south as far as Coleman and east to Marinette, a total of fifty-one miles, to the Wisconsin Telephone Company.

ALMA, NEB.—The stockholders of the Farmers and Merchants' Telephone Company at their annual meeting elected R. L. Keester, president and general manager; F. W. Steven, treasurer, and T. L. Porter, secretary. The company now has 250 telephones in operation in Harlan County.

VICTORIA, BRITISH COLUMBIA—The International Telephone Company has completed arrangements whereby Victoria and other places on Vancouver Island are to have telephonic connection with points on the inland as far south as Portland, Ore. The cable has been ordered and will arrive about the middle of April or the end of May, and it is expected that it will be in service by the fall.

MINNEAPOLIS, MINN.—It is stated that the Northwestern Telephone Company will carry out proposed improvements, aggregating in the neighborhood of a million dollars, during the present year. Most of the improvements will be made in Minneapolis and St. Paul. The underground system will be greatly enlarged and the overhead cable system improved wherever necessary. In addition to the local improvements, the company will build new toll lines and establish exchanges wherever needed.

PERSONAL MENTION.

MR. W. T. COOKE, who was superintendent of motive power of the St. Louis Transit Company, St. Louis, Mo., has resigned.

MR. ELLWOOD MATEER has been appointed manager of the Pennsylvania Telephone Company, at Lock Haven and Renovo, Pa.

MR. W. NORMAN DIETRICH has been appointed electrical engineer of the Canadian Pacific Railroad, with offices at Montreal, Quebec.

DR. R. B. OWENS, of McGill University, delivered a lecture recently before the Insurance Institute, of Montreal, upon "Interior Electric Wiring."

MESSRS. CLARKE AND MACMULLEN, INC., electrical and consulting engineers, have moved their Pittsburg, Pa., offices to the Farmers' Bank Building.

DR. J. H. VAN'T HOFF, eminent as one of the founders of the theory of dissociation, has been made an honorary doctor of medicine by the University of Utrecht.

MR. F. V. T. LEE has been appointed manager of the new offices which the Fort Wayne Electric Works has opened at 69-75 New Montgomery street, San Francisco, Cal.

MR. H. A. WALDRON, assistant superintendent of the Chicago & Joliet Electric Railway, has resigned to become superintendent of the Urbana & Champaign Electric Street Railway, at Champaign, Ill.

MR. H. CHAPMAN, who is connected with the Montreal Street Railway, Montreal, Quebec, has been appointed superintendent of construction of the company. Mr. Chapman succeeds the late Mr. Vinden.

MR. C. E. BROWN returned from Europe last week after three months of research work in different parts of the Continent as electrical engineer of the Canadian Electrothermic Iron and Steel Commission.

MR. EMIL O. LUNDIN, president of the Lundin Electric and Machine Company, Boston, manufacturer of a line of equipments used in central stations, who has recently returned from Havana, was a New York visitor last week.

DR. F. W. GUNSAULUS, president of the Armour Institute of Technology, Chicago, Ill., has accepted the invitation of the Louisiana Purchase Exposition Company to deliver the invocation at the opening ceremonies of the fair, to be held on April 30, 1904.

MR. E. Z. BURNS, former city engineer of Niagara Falls, N. Y., it is stated, will have charge of local operations during the engineering work on the Lockport power canal. Mr. Burns is a graduate of the Lockport high school, and is well known throughout Niagara County.

MR. JOSEPH CACCAVAJO, C. E., has been appointed civil engineer of the Western Union Telegraph Company, with headquarters in the Western Union Building, New York city. Mr. Caccavajo's new work will not interfere with his private practice as consulting engineer.

M. EMILE GUARINI, the well-known writer upon technical subjects, has published, in pamphlet form, an address delivered before the Société Centrale d'Agriculture de Belgique. This gives a good review of the use of electricity, both for stimulating plant growth and as a power for cultivating the soil.

MR. C. A. DENMAN, who was superintendent of the Richmond Street and Interurban Railway Company, Richmond, Ind., has been succeeded by Mr. Albert Gordon, formerly connected with the La Fayette Street Railway, La Fayette, Ind. It is reported that Mr. Denman will enter into telephone business in the South.

MR. T. E. JOHNSON, who was recently appointed cashier of the Chattanooga exchange of the East Tennessee Telephone Company, has been appointed traveling auditor of the company, with headquarters in Asheville. Mr. Johnson has been connected with the Chattanooga exchange for a little more than a year, having commenced as collector.

MR. CARL SCHWARTZ, formerly of the Berlin Allgemeine Company, has been appointed assistant engineer on the engineering staff of the New York Central Railroad, and will be connected with the designing and erection of the electrical parts of the traction power stations the company is to build. Mr. Schwartz was at one time chief engineer for the Siemens & Halske Company, St. Petersburg, Russia.

MR. JOSEPH E. LOCKWOOD, 106 Woodward avenue, Detroit, Mich., has been appointed Michigan sales agent for the Bullock Electric Manufacturing Company, Cincinnati. Mr. Lockwood is one of the pioneer electrical supply men of the country, and is in close touch with the electrical field all over the United States. In addition to the Bullock company, Mr. Lockwood will act as representative for several other interests.

MR. M. R. HUTCHISON, of New York city, lectured on Wednesday evening, April 20, on "The Hutchison System and Apparatus for the Alleviation of Deafness and the Instruction of Deaf Mutes," at the Franklin Institute, Philadelphia. Mr. Hutchison described and exhibited various electromechanical appliances he has devised for the treatment of deafness and the education of deaf mutes. The system and apparatus are said to be radically new and scientific in principle, and to have yielded surprisingly good results.

MR. WALTER P. PHILLIPS, for some time past advertising manager of the Columbia Phonograph Company, superintendent of

printing, editor of the *Columbia Record*, and general expert, with offices in Bridgeport, Ct., has been transferred to the company's offices in New York city, N. Y., where he will hereafter make his headquarters. He will, however, continue in charge of the printing department and will spend one or two days of each week in Bridgeport. Mr. Phillips has recently been elected vice-president of the United Electrical Manufacturing Company, a concern which will manufacture the autoplex, an invention of Mr. Horace G. Martin. The autoplex, together with the "Phillips" system of telegraphy, will be shown at the St. Louis fair.

MR. WILLIAM J. HAMMER, the well-known electrical engineer, of New York city, met with an unfortunate accident while on his way from Providence, R. I., to New York, on Sunday, April 17. Mr. Hammer was in attendance at a radium dinner given in Providence on Saturday evening, April 16, and after dinner spent the night at the home of Colonel Gardiner C. Sims. Colonel Sims is greatly interested in military and naval engineering, and had a large number of photographs in connection with the subjects. In addition, he had a mass of correspondence with naval and military men from all over the world, and these letters were prized very highly. This correspondence, together with the photographs, had been placed in a scrapbook, and on Sunday morning Mr. Hammer enjoyed a perusal of this matter on his way to New York. Leaving his seat for a moment just before reaching New Haven, the book was stolen, and, although careful enquiry was made on the train, it could not be found. With characteristic energy, Mr. Hammer inspired a thorough search by the railroad company and the police department, with the result that on the morning of April 20, the portfolio was delivered by mail to police headquarters and turned over to Mr. Hammer by Inspector McCluskey.

MR. ARTHUR WARREN, the chief of the department of publicity of the Allis-Chalmers Company, is one of the most widely known workers in the special field of the promotion of publicity. Mr. Warren was prepared for the technical side of his work by considerable active machine-shop practice. In 1883, after considerable traveling and writing upon the subject of his travels, Mr. Warren joined the staff of the Boston *Herald*. He remained with this newspaper for fourteen years, and became its leading special article writer, discussing many topics and taking up, among these, the field of biography and dramatic and literary criticism. During this time Mr. Warren engaged in other editorial work, becoming assistant editor of the Boston *Beacon*, and was editor of the Boston *Home Journal* from 1886 to 1888. He was sent abroad as its London correspondent by the Boston *Herald* in December, 1888, and served in this capacity for nine years. At the same time, he wrote for a number of other American and British publications. Mr. Warren still retains his London home, which has become a centre of social and literary intercourse. Returning to the United States at the invitation of Mr. George Westinghouse in November, 1897, he organized the Westinghouse Companies' Publishing Department. Having brought this department up to a remarkably efficient condition and organized the work along such practical lines that it could be systematically carried on, Mr. Warren resigned, becoming actively engaged in New York city in literary work for leading magazines and newspapers in various fields. He had planned to sail for Europe on March 12, when he was invited by the executive of the Allis-Chalmers Company to take up the duties of the chief of the department of publicity, under the reorganization of this company. There is no doubt that Mr. Warren is preeminently qualified by his experience and talents to make this a most successful department. The publicity department of these large corporations has become of the utmost importance, and it is only a man who possesses the excellent qualities which Mr. Warren represents, who can expect to cope with the magnitude of such an undertaking.

ELECTRICAL SECURITIES.

Quite contrary to the advances which have been made during recent weeks, the past week seems to have settled the conviction that there was about to begin a reaction. While the market evidenced a firm undertone, there was a diminution of interest, and commission houses report an almost total lack of support from outside investors. This has been brought about by the fact that, just as soon as more than ordinary strength was shown in the investment demand, large corporations immediately put forward heavy advances, which checked all tendency to engage in new ventures. The rumors of extensive loans in foreign markets brought about a condition of uneasiness there which has been reflected with more than usual strength in the home financial centres. Added to this, there have been several bad reports showing decreases in both exports and imports, and a considerable shrinkage in the excess of exports over imports for the last month. Reports are also at hand showing idle equipments for several large railroads, a thing which has not been known for many years. The present tendency of the larger industrial corporations is toward extreme conservatism, and the passing of dividends and the attempt to add to the surplus account, while indicative of stable organization and good financial judgment, do not conduce to attract new investing capital.

ELECTRICAL SECURITIES FOR THE WEEK ENDING APRIL 16.

New York:	*Closing.*
Brooklyn Rapid Transit	46¼
Consolidated Gas	205¼
General Electric	104
Kings County Electric	183
Manhattan Elevated	142
Metropolitan Street Railway	113½
New York & New Jersey Telephone	141
Westinghouse Manufacturing Company	175

The General Electric Company announces a special meeting of the stockholders of the company, to be held at Schenectady, N. Y., on Tuesday, May 10, at 2 o'clock P. M., for the purpose of voting upon a proposition to increase the capital stock of the company by the amount of $3,325,500, consisting of 33,255 shares of the par value of $100 each, so that the capital stock shall be increased from the present amount, *viz.*, $45,000,000, consisting of 450,000 shares of the par value of $100 each, to $48,325,500, consisting of 483,255 shares of the par value of $100 each. The annual meeting of the company will be held at 12 o'clock noon of the same day.

Boston:	*Closing.*
American Telephone and Telegraph	126
Edison Electric Illuminating	234½
Massachusetts Electric	74½
New England Telephone	126
Western Telephone and Telegraph preferred	80

The annual meeting of the New England Telephone and Telegraph Company will be held in New York city on May 2. Transfer books will remain closed from April 22 to May 6.

Announcement has been made that the American Telephone and Telegraph Company has negotiated the sale of $20,000,000 of 5 per cent notes to a syndicate consisting of Speyer & Company, of New York, and Lee, Higginson & Company, of Boston. The notes now decided upon instead of bonds will run for three years from May 2, 1904, in coupon form, and the principal and interest are payable in gold. The notes will be secured by $25,000,000 of the company's 4 per cent bonds as collateral.

Philadelphia:	*Closing.*
Electric Company of America	7⅞
Electric Storage Battery common	57
Electric Storage Battery preferred	57
Philadelphia Electric	5½
Union Traction	49½
United Gas Improvement	83

At the annual meeting of the stockholders of the Philadelphia Electric Company, held at Camden, N. J., April 13, it was reported that 877,108 sixteen-candle-power lamps were contracted for in 1903, an increase of 108,278 over the previous year. The annual report for the year ended December 31, 1903, compares with 1902 as follows: gross income, all sources, $3,665,045, against $3,422,411; operating expenses, taxes and fixed charges, $3,053,443, against $2,967,968; balance to be added to surplus account, $611,602, against $454,442; less dividends, $375,035, against $337,552; surplus December 31, $800,134, against $563,567. The following board of directors was elected: Thomas Dolan, Jeremiah J. Sullivan, William F. Harrity, John V. Shoemaker, Charles M. Swain, Charles E. Ingersoll, Joseph B. McCall, William P. Conover, Jr., and A. V. R. Coe.

Chicago:	*Closing.*
Chicago Telephone	117
Chicago Edison Light	150
Metropolitan Elevated preferred	47½
National Carbon common	29¾
National Carbon preferred	98
Union Traction common	5⅞
Union Traction preferred	30¾

ELECTRIC RAILWAYS.

BUFFALO, N. Y.—Robert Stuart has taken over the Peterboro (Canada) street railway, and will rebuild and extend the line to Lakefield.

CLEVELAND, OHIO—The council of Euclid Heights village has granted a twenty-five-year franchise to the Shaker Heights & Boulevard Railway Company.

EXCELSIOR SPRINGS, KAN.—A project is on foot to build an electric line between Kansas City and Excelsior Springs. Kansas City capitalists are mainly interested.

ROCKFORD, ILL.—The Kenosha Electric Railway Company has decided to increase its capital from $10,000 to $150,000, to provide for extensions to be made during the coming summer.

MEMPHIS, TENN.—The Mississippi Land and Investment Company has been chartered to build a trolley line between Vicksburg and Jackson, Miss. Surveys have been commenced and the road will be built as soon as possible.

WASHINGTON, PA.—The Wheeling Traction Company has paid $40,000 for rights of way between West Alexander and Claysville, and will commence the work of construction shortly. The road will parallel the Baltimore & Ohio for some distance.

DANVILLE, ILL.—The San Francisco Railway Company will build an electric railway between this city and Oaktown, a distance of four miles. The track will be laid on its own right of way, and will run parallel to the Danville street railway line.

VALPARAISO, IND.—A franchise has been granted to the Northern Indiana Traction Company by the city council. The line will connect South Bend, Laporte, Valparaiso and Hammond. The president of the company announces that work will begin at once.

JAMAICA, N. Y.—Work on the new line of the Long Island Traction Company from Rockville Centre to Lynbrook, Valley Stream, Jamaica and Woodhaven, will be started at an early date, and it is said that by midsummer cars will be running to Jamaica.

DOYLESTOWN, PA.—Work has been started on the construction of the Souderton & Trooper Trolley Railway, which is to traverse a thickly settled agricultural district for sixteen miles. The new line will form an important link in the trolley system centering in and about Norristown.

AURORA, ILL.—It is reported that the promoters of the Fox River Traction Company have succeeded in securing the necessary capital to build their electric line from Yorkville to Plano, thence to Sandwich, and that work will commence as soon as the necessary rights of way are granted.

TOPEKA, KAN.—Work has been commenced on the interurban electric line which will connect Independence, Kan., with surrounding towns of the gas and oil belt. The road will be nearly fifty miles in length, and is to be built for passenger and freight traffic. It is expected to have the road in operation by September.

LIMA, OHIO—After a meeting of the directors, Henry G. Paul announced that work on the Ft. Wayne-Lima-Delphos-Van Wert Traction Company's lines, paralleling the Pittsburg, Ft. Wayne & Chicago, would be resumed at once with a full force, and that cars would be running between Lima and Ft. Wayne on regular schedule by August 1 at the latest.

LITTLE ROCK, ARK.—A company has been formed to build a road from Oakland, on the Illinois Central, to Charleston, the county seat of Tallahatchie County, Miss. The length of the proposed road is about ten miles, and the capital stock of the company is $125,000. Joseph Larimer, John W. Saunders and W. F. Lambert are back of the project.

HAMMOND, IND.—Articles of incorporation for the Hammond Belt Railway Company, with principal offices in Chicago and a capital stock of $50,000, have been filed in the office of the secretary of state at Springfield, Ill. The proposed line is to be constructed from a point on the Illinois-Indiana line near Hammond in a northwesterly direction to Calumet Park, Ill.

WATERTOWN, WIS.—The council has granted to the Oconomowoc Heat, Light and Power Company a franchise to build an electric railway through the city and to use several streets for a term of forty-five years. The intention is to build a line to Madison as soon as possible, and possibly a branch may be extended southward to Johnson Creek, Lake Mills, Jefferson and eventually to Janesville.

GREENWOOD, MISS.—The promoters of the interurban railroad to run from this city to Itta Bena, eight miles distant, announce that sufficient capital has been secured to ensure the building of the line. The plan is to build and equip at least two lines in the city and complete the road as far as Itta Bena without delay, and to finally extend the system to Indianola, Leland and Greenville.

JOLIET, ILL.—Work has been begun on the Aurora extension of the Joliet & Aurora Electric Railway Company, and it is expected to have the line completed to this city by the middle of summer. It will then be possible to go by street cars to Milwaukee, through Rockford, Janesville, etc., and back to Joliet through Chicago, with the exception of about twenty miles between Milwaukee and Chicago.

LEXINGTON, OKLA. TER.—The directors of the proposed electric railway from Oklahoma City *via* Lexington to Sulphur Springs, Ind. Ter., held their first regular meeting recently and elected officers for the new road as follows: Charles A. Stewart, of Parkersburg, W. Va., president; Jay Sherman, first vice-president; Edgar J. Kellar, second vice-president; H. A. Hawk, treasurer; George A. Teague, secretary.

WASHINGTON, D. C.—The Old Dominion and Great Falls Railway Company, which is building a line from the Washington side of the Aqueduct bridge up the Virginia side of the Potomac to Great Falls, has purchased a tract of land for its power-house near the Virginia end of the Aqueduct bridge, and will begin the work of construction immediately. The grading work on the route of the railway is progressing rapidly.

PEEKSKILL, N. Y.—The Danbury & Harlem Traction Company has been incorporated to build an electric road from Danbury, Ct., to Golden's Bridge, thus giving the northern part of the county a rapid transit system. From Golden's Bridge it is the intention to extend the road southward to Mount Kisco, and thence northwestward to Peekskill, going by the way of Lake Mahopac. Engineers are now making surveys for the line.

CORTLAND, N. Y.—The Cortland County Traction Company is endeavoring to secure rights of way over private land upon which to build the extension of the line from Homer to Little York. The company has franchises over both the east and west roads from Homer to Little York, but it prefers to build on private land. Permission has been granted in a large number of cases, and the outlook is favorable for running the extension outside of the highway.

PORTLAND, ORE.—Work on the Oregon Traction Company's proposed electric road from Portland to Hillsboro, *via* Forest Grove, will begin in the near future, a deal having been completed for the disposal of $500,000 worth of bonds to parties who will push the project to completion immediately. The estimated cost of the road is $525,000. According to the present plans of the company, the line will in time be extended into the Tillamook country, and beyond to the ocean.

NEW LONDON, CT.—The franchise and good will of the East Lyme Street Railway Company have been taken over by Morgan & Phelps, of New York city, and the purchasers will take immediate steps to perfect the organization of the company. The capital stock will be fixed at $150,000. The company has a charter for the construction of a street railway from New London through the town of Waterford to East Lyme. It will immediately have surveys prepared, after which contracts for the construction of the road will be awarded.

LEAD, S. D.—It is announced that an electric railroad connecting Lead with the coal mines of northeastern Wyoming is to be built. The promoters state that the preliminary survey will be made as soon as possible. This road will be between forty and fifty miles in length, and it is proposed to build it by way of Welcome City, Wyo., and Cyanide, S. D. The Economic Power Company holds a bond on a large area of coal land twelve miles from Sundance, where it proposes to establish a power plant and distribute electrical energy throughout the Black Hills.

ELECTRIC LIGHTING.

TERRE HAUTE, IND.—The Terre Haute Electric Company expects to have its new power-house ready by August.

LEWISTON, PA.—The contract for street lighting has been awarded to the Lewiston Electric Light Company, at $65 per light.

LIMESTONE, ME.—An electric light plant will be established here. Power will be secured from a mill one and one-half miles from the village.

CHATTANOOGA, TENN.—The report of the board of public works shows that the annual cost of lighting the city under the present contract is $20,391.25.

FAYETTEVILLE, W. VA.—It is stated that a company composed of local and Charleston capitalists will install an electric light and ice plant in Beckley in the near future.

COLUMBUS, GA.—The Columbus Railroad Company has been awarded a three-year contract for street lighting, to go into effect December 31, 1904. Under this contract the city is to pay at the rate of $60 per light for 167 or more lights.

HATTIESBURG, MISS.—The city council has passed an ordinance voting $60,000 for the purpose of putting in an up-to-date electric light plant, as the present plant, owned by a private company, is not sufficiently large to meet the demands made upon it.

TROY, N. Y.—A trust mortgage at six per cent, in the sum of $75,000, executed by the Halfmoon Light and Power Company, of Mechanicville, to the Adirondack Trust Company, of Saratoga Springs, has been filed for record in the Saratoga county clerk's office.

KNOXVILLE, TENN.—The citizens of Maryville, Blount County, have a movement on foot to organize a company and dam Little river at a point three miles from Maryville. This will give the company sufficient power, and the plans are to erect a light plant and thus secure better lighting facilities for the town.

FREDERICKSBURG, VA.—Messrs. Cartwright and Davis, representing northern capitalists, have purchased the Fredericksburg water power, comprising the large dam across the Rappahannock river, one mile above the city, the distributing canal and all rights and franchises. The property, which is very valuable, will be put in first-class condition and will be thoroughly developed.

JACKSONVILLE, FLA.—The board of bond trustees has decided to purchase additional machinery for the city electric light plant, as the plant is now working on full load. It is estimated that the generator required will cost $18,000, and the necessary supplies $10,000. If the present rate of increase in demand for lights is maintained, it will probably be necessary to install a generator of 1,000-kilowatt capacity within a year.

WOODBURY, CT.—The Woodbury & Seymour Street Railway Company, which has a franchise to operate a lighting business within the towns of Woodbury, Southbury, Oxford and Seymour, has perfected arrangements for the establishment of an electric light plant in this town. The plan contemplates the development of a storage reservoir covering an area of thirty acres. From this reservoir the water will be conducted 1,600 feet through a flume to the power station.

MINNEAPOLIS, MINN.—Owing to the fact that the Minneapolis Retailers' Association has been able to make satisfactory arrangements with the Minneapolis General Electric Company, it will not install an independent electric plant, as proposed, for some time. The General Electric Company has agreed to furnish current at the following rates: a flat maximum rate of 10 cents to all mercantile consumers; a minimum rate of 7½ cents to all using more than $2,000 of light and power combined per year, and 6¾ cents to all using $3,600 of light alone. This agreement went into effect April 1, 1904, and is for one year from that date.

ILION, N. Y.—The board of light commissioners has submitted a report of the transactions of the municipal lighting plant for the eleven months from April 1, 1903, to March 1, 1904, showing the receipts to be: appropriation, $7,000; cash for light, power and supplies, $6,822.60; deficiency, $6,316.44; total, $20,139.04. Disbursements—Cost of running plant for eleven months; salaries, $3,155.69; coal, $7,327.95; supplies, $357.31; maintenance, $1,490.98; total, $12,331.93; extension meters, house connections, etc., $2,841.86; accounts contracted prior to April 1, 1903, $2,985.25; bond and interest, $1,980; total, $7,807.11. The estimate given for the coming year is: salaries, $3,300; coal, $8,000; supplies, $300; maintenance, $1,820; bond and interest, $2,080; extensions, $500; a total of $16,000, which with estimated receipts of $7,000, would show a deficiency of $9,000, which the commissioners ask to have included in the budget. The board explains the large deficiency by the fact that meters have been purchased, and to the item for old accounts paid by the commission of $2,985.25, as well as the fact that the light furnished for public services, for which no remuneration is received, would, at current rates, add to the income of the plant nearly $400.

AUTOMOBILE NOTE.

REOPENING OF GORDON-BENNETT CUP RACE ENTRIES—The racing committee of the Automobile Club of America announces that it will receive additional entries for the Gordon-Bennett cup race up to and including May 1, 1904, on which date all cars entered for the race must be ready for inspection and trial by the committee. The original conditions of entry, as heretofore published, will govern.

OBITUARY NOTICE.

MR. JAMES W. HINKLEY, president of the United States Casualty Company, of New York, and for a number of years prominent in business and politics in New York state, died suddenly on April 11, at his home, Eden Hill, Syracuse, N. Y. Mr. Hinkley was born in Jackson, Clinton County, N. Y. After his graduation from the United States Military Academy at West Point Mr. Hinkley engaged in newspaper work, and eventually became editor and owner of the *New Press*, of Poughkeepsie. He afterward purchased and assumed the chief editorial position on the New York *Daily Graphic*. He was very prominent in Democratic politics in New York state. Besides being president of the United States Casualty Company, Mr. Hinkley was also president of the Poughkeepsie City & Wappinger Falls Railway Company; president of the Walker Electric Company; president of the Consolidated Electric Light and Power, and Consolidated Light, Heat and Power companies, of Poughkeepsie, and the Poughkeepsie News Company. He was vice-president of the Roebling Construction Company, and a director of the Consolidated Car Heating Company, the International Bank and Trust Company of America, the National Bank of North America, and the Poughkeepsie Trust Company.

NEW INCORPORATIONS.

LANSING, MICH.—Elwell Telephone Company. $1,000.

JACKSON, MICH.—Leoni Central Telephone Company. $475.

DOVER, DEL.—The Havana Electric Light and Power Company. $500,000.

RICHMOND, VA.—Sussex & Southside Telephone and Telegraph Company. $5,000.

SCOTCHTOWN, N. Y.—Scotchtown Telephone Company. $2,000. Incorporators: M. H. Santee, of Circleville, and others.

NELSON, NEB.—Nuckolls County Telephone Company. $50,000. To establish a system of rural telephones throughout the county.

CARNEY, OKLA. TER.—The Carney Automatic Telephone Company. $10,000. Incorporators: C. L. Page, C. E. Wilcox, M. A. Smith.

HANSKA, MINN.—Hanska Rural Telephone Company. $50,000. Incorporators: D. F. Wood, George Chambard, C. I. Stone and others.

CAMDEN, N. J.—The Baxter Lighting Company. $25,000. Incorporators: Lewis F. Baxter, George M. De Gunther and L. Howard Weatherby.

DALEVILLE, IND.—Daleville Telephone Company. $1,000. Directors: Thomas Bromley, F. D. Rushing, R. E. Stone, Grant Frantzell and Charles H. Forrest.

HARRISBURG, PA.—Interstate Street Railway Company; $200,000; to build a line from Port Allegheny to Coudersport, through the villages of Roulette and Mina, a distance of twenty miles. Allen Street Railway Company; $30,000; to build five miles of road in Northampton County.

INDUSTRIAL ITEMS.

THE WHEELER CONDENSER AND ENGINE COMPANY recently moved its New York offices to 42 Broadway.

THE AMERICAN BUSINESS SYSTEMS COMPANY, Boston, Mass., is sending out its 1904 catalogue of equipments. Catalogue will be sent on request.

THE BUFFALO FORGE COMPANY, Buffalo, N. Y., describes, illustrates and lists in its circular No. 100, which it has sent out, "Buffalo" geared hand blowers.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., announces that it has opened an office at 69-75 New Montgomery street, San Francisco, Cal., in charge of Mr. F. V. T. Lee.

THE CANCOS MANUFACTURING COMPANY, Philadelphia, Pa., is distributing a circular which contains some statements in connection with "Black Squadron" ring packing. Circular will be sent on request.

THE LAMBERT SCHMIDT TELEPHONE MANUFACTURING COMPANY, Weehawken, N. J., is distributing a catalogue descriptive of its interior telephones. This catalogue is No. 11, and the company will be pleased to send it on request.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., publisher of "The Emerson Monthly," has issued the April, 1904, copy. This publication contains many interesting articles and illustrations. Copy will be sent on request.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., is distributing a circular descriptive of "Dixon's" motor chain compound. The circular also contains information as to the proper care of driving chains. This circular will be sent on request.

THE AMERICAN PUSH-BUTTON TELEPHONE COMPANY, 136 Liberty street, New York city, N. Y., announces that it has been authorized by the court to change its legal name to Anders Push-Button Telephone Company, which will go into effect on and after May 7, 1904.

THE LOUISIANA PURCHASE EXPOSITION COMPANY has issued, under the auspices of the press and publicity department, a booklet containing a map of the fair grounds, information concerning the hotels of St. Louis, facts about the exposition, a map of St. Louis, showing location of fair grounds, etc.

THE NERNST LAMP COMPANY announces that its Boston office, formerly located at 131 State street, has been moved to 501 Atlantic avenue. The office will, as heretofore, be in charge of Mr. George C. Ewing as district manager, and will carry a complete line of Nernst lamps and supplies, ensuring prompt delivery of orders.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing a handsome catalogue illustrating and listing 1904 Diehl direct-current fan motors. This catalogue is an exceedingly attractive little book, and the company requests that all dealers who are interested, and who have not received a copy, should write for one.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, manufacturer of elevating, conveying, power transmission, screening, crushing, dredging, coal and rock drilling, coal cutting, hauling and washing machinery, has sent out its circular No. 73, which contains many illustrations of its various manufacture. Circular will be sent on request.

AT THE MEETING of the electrical jobbers in Buffalo last week, Mr. A. C. Garrison distributed, on behalf of the Columbia Incandescent Lamp Company, St. Louis, Mo., a very popular little souvenir in the shape of a small leather pocket-book. It was in great demand. Another souvenir distributed was a leather match-holder with the compliments of the Chicago Pneumatic Tool Company.

JAMES S. BARRON & COMPANY, 339-343 Greenwich street, New York city, N. Y., announces that in spite of the fire which recently destroyed its building and all the contents, amounting to $185,000, it has taken new quarters at the above address, where it expects to remain until the completion of its new building on the old site, which will be about May, 1905. The damage was fully covered by insurance.

THE NEW HAVEN MANUFACTURING COMPANY, New Haven, Ct., of which Mr. Leslie Moulthrop is general manager, has had Dodge & Day, modernizing and contracting engineers, Philadelphia, Pa., go over its plant with a view of bringing it up to date in every respect. Complete rearrangement of the shop is contemplated, and it is probable that a number of the old machine tools will be replaced by modern apparatus.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, furnished all of the heat and cold insulating materials required for the boilers and pipes in the new palace built for the Japanese crown prince. Incidentally, it might be noticed that the entire mechanical equipment, including the boilers, engines, heating, ventilating, electric light plants and refrigerating plant, is of American design and American manufacture.

THE H. R. WORTHINGTON COMPANY'S hydraulic works, which were located in Brooklyn, N. Y., for a number of years past, are soon to move, it is reported, to its new quarters located at Harrison, N. J. Two years ago the company made its preliminary moves toward the change of base for its operations. Thirty-five acres of land were purchased at Harrison, and the work of designing plans and experimenting for foundations was begun. The company is one of the oldest and largest manufacturing concerns in Brooklyn, N. Y.

THE WESTINGHOUSE MACHINE COMPANY, East Pittsburg, Pa., has published a booklet descriptive of the Westinghouse-Parsons steam turbine. This booklet, which is splendidly printed and substantially bound in a decorated cover, takes up in detail the history of the steam turbine *versus* piston engines. It also gives a brief résumé of the efforts to build a practical steam turbine up to the present time. A careful description of the mechanism of the steam turbine is supplemented by clearly printed half-tone illustrations. The results of a number of tests are given, showing the efficiency of various types of Westinghouse-Parsons steam turbines.

DODGE & DAY, modernizing and contracting engineers, Nicetown, Pa., report that they are preparing plans for extensive improvements in the Phœnix Cement Company's plant at Nazareth, Pa. Most of the company's buildings will be enlarged, electrical transmission will be used throughout, and the entire plant will be modernized in order to materially increase its output to meet the growing demand for its product. There will be installed considerable new apparatus, including a 200-kilowatt generator and a tandem-compound engine for running it, a fifty-horse-power motor and a seventy-five-horse-power motor as well as a number of smaller ones, an electric hoist, air compressor, blower, exhauster and elevators, etc.

LEGAL NOTES.

EXECUTION AGAINST ELECTRICAL CORPORATION—An execution has been awarded against Thompson, Son & Company, New York city, dealers in electrical machinery, for $3,140, in favor of Henry Schroeder, on two notes payable on demand. Payment was demanded on August 21 last, and not made. Mr. Schroeder was formerly treasurer of the corporation. The company was incorporated in February, 1901, with a capital stock of $100,000, and has a workshop in Brooklyn, N. Y.

THE SELF-RESTORING DROP PATENT LITIGATION—In the United States Circuit Court of Appeals, Chicago, April 12, 1904, a decision was handed down in favor of the Western Telephone Manufacturing Company, in the self-restoring patent suit on patent No. 521,461, granted June 19, 1894. Judges Jenkins, Grosscup and Baker were in attendance, and the opinion of the court was delivered by Judge Baker. The suit is apt to involve several hundred thousands of dollars, as the opinion is broad and sweeping, covering all switchboard drops located with their associated jacks, and adapted to be restored by the operator's plug as it is thrust into the jack automatically. This suit was brought by Mr. James Keelyn, of the Western Telephone Construction Company, in the United States Court in June, 1897. In 1903 Judge Kohlsaat gave an unsatisfactory decision, holding that the patent was good and valid, but that it was not infringed. An immediate appeal was made to the United States Court of Appeals, and the latter heard the oral arguments on January 20, 1904, with the above result. The patent has seven years more to run.